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Location Decisions with Innovative Production Facilities: A Case Study of the Adidas Speedfactory

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Table of Contents

LIST OF FIGURES ..... **III**

LIST OF LISTS ..... **III**

LIST OF TABLES ..... **III**

LIST OF ABBREVIATIONS ..... **IV**

1 INTRODUCTION **1**

2 LITERATURE **2**

2.1 INTERNATIONAL BUSINESS FRAMEWORKS 3
2.2 DRIVERS OF LOCATION DECISIONS 4
2.2.1 Offshoring *4*
2.2.2 Reshoring *7*
2.3 INDUSTRY 4.0 AND LOCATION 11

3 METHODOLOGY **12**

4 THE ADIDAS SPEEDFACTORY **15**

4.1 STATUS QUO 16
4.2 INITIAL IDEA OF THE SPEEDFACTORY 18
4.3 SPEEDFACTORY TECHNOLOGIES 20
4.4 SCALING OF THE SPEEDFACTORY 23
4.5 EVOLVING BUSINESS MODEL 28
4.6 3D PRINTING AND THE SPEEDFACTORIES 29
4.7 TERMINATION AND RELOCATION TO ASIA 33

5 CASE ANALYSIS **34**

5.1 DRIVERS OF RESHORING VIA THE SPEEDFACTORIES 35
5.1.1 Drivers *36*
5.1.2 Synthesis *40*
5.2 DRIVERS OF OFFSHORING THE SPEEDFACTORIES TO ASIA 43
5.2.1 Drivers *44*
5.2.2 Synthesis *48*

6 DISCUSSION **52**

6.1 RESULTS 52
6.1.1 Location decisions with innovative production facilities *52*
6.1.2 Effect of innovative production facilities on location decision drivers *55*
6.1.3 Novel reshoring drivers *58*
6.1.4 Implications of innovative production facilities on reshoring and offshoring *59*
6.2 LIMITATIONS 61
6.2.1 Internal validity *61*

6.2.2 External validity *63*

7 CONCLUSIONS **63**

7.1 MANAGERIAL IMPLICATIONS 65
7.2 RESEARCH DIRECTIONS 66

APPENDIX **68**

A FIGURES 68
B LISTS 69
C TABLES 73
D REFERENCES 78

List of figures

Figure 1 – Offshoring drivers in literature p. 5

Figure 2 – Reshoring drivers in literature p. 8

Figure 3 – Adidas' footwear production by country from 2015 to 2019 p. 17

Figure 4 – Adidas' sales by market in 2019 p. 19

Figure 5 – Drivers of Adidas' reshoring decision p. 41

Figure 6 – Drivers of Adidas' offshoring decision p. 49

Figure 7 – Futurecraft M.F.G. and AM4TKY p. 68

Figure 8 – Futurecraft 4D and ZX 4000 4D p. 69

List of lists

List 1 – Questions guiding the data collection procedure p. 69

List 2 – Prepared interview questions for Interviewee A p. 72

List of tables

Table 1 – Adidas' AM4 series from the Speedfactory p. 73

Table 2 – Adidas' 4D-series p. 75

List of abbreviations

3D printing	three-dimensional printing
CLIP	Continuous Liquid Interface Production
DLS	Digital Light Synthesis
e-TPU	expanded thermoplastic polyurethane
e.g.	exempli gratia
I4.0	Industry 4.0
i.e.	id est
IoT	Internet of Things
KPI	key performance indicator
n.d.	no date
OLI	ownership, location, internalization
R&D	research and development
RBV	resource-based view
TCE	transaction cost economics
US	United States of America

1 Introduction

The specific location of production can give a firm competitive advantages (Whitfield, 2017). Hence, location decisions concerning production are an integral part of business strategy and have been studied in-depth ever since the first offshoring waves in the last century (e.g., Dunning, 1980). Within the past 20 years, location decisions gained in complexity with a multitude of factors becoming relevant whereas previously cost differentials predominantly determined the optimal location (Kinkel and Maloca, 2009, Di Mauro et al., 2018). Concurrently, manufacturing began to gradually transform in recent years driven by technological advancements, bundled under the umbrella term Industry 4.0 (De Backer et al., 2018; Ancarani et al., 2019; Biswas, 2018, p. 137). As a result, the first highly innovative production facilities emerged, which I define as factories employing a variety of Industry 4.0 technologies to enable automated production. One prime example of an innovative production facility is the Speedfactory by Adidas (Biswas, 2018, pp. 136-137). With this new type of production, the question arises whether and how location decisions concerning these innovative production facilities differ from previously studied location decisions. Since this is a newly emerging subcategory of location decisions, this question is still largely under-researched. The purpose of this study is to fill this void by exploring the implications of innovative production facilities on the respective decision where to locate them. Note that location decisions can refer to both the initial decision of where to locate new factories as well as subsequent relocation decisions. Moreover, I aim to identify location drivers that are specifically relevant for this type of location decisions and how the characteristics of this novel factory type affect the plethora of drivers identified in literature. Given the lack of broad empirical data due to the novelty of this research field, I use an

exploratory single case study of the Adidas Speedfactory following the methodology outlined by Yin (2018) to answer these research questions.

The remainder of this paper is organized as follows. Chapter 2 presents the relevant theoretical background and summarizes major drivers of location decisions identified in research literature. Chapter 3 outlines the case study methodology by describing the data collection procedure and analytical methods. In chapter 4, I illustrate the case of the Adidas Speedfactory in-depth as the basis for the subsequent analysis of the observed location decisions in chapter 5. Next, I link the results from the case analysis to the research questions by trying to generalize previous findings while also discussing limitations in chapter 6. Lastly, chapter 7 will conclude, discuss practical implications and offer potential directions for future research.

2 Literature

By choosing the right location, firms can gain a competitive advantage (e.g. Dunning, 1998; Porter, 1990). This paper is concerned with the location of production facilities, which too can yield competitive advantages (Whitfield, 2017). The importance of location decisions further increased as globalization enabled a plethora of options where to set up production (Grossman and Rossi-Hansberg, 2008; Johansson and Olhager, 2018), each with a distinct set of local factors (Porter, 1994).

For the purpose of this paper, two types of location decisions are of interest: offshoring and reshoring. Offshoring means the full or partial relocation of production to a foreign country (Canham and Hamilton, 2013). Conversely, reshoring refers to the full or partial relocation of production back to the home country of the firm (Fratocchi et al., 2013). However, the term reshoring can be used irrespective of whether offshore production is substituted or complemented (Martinez-Mora and Merino, 2014; Fratocchi

et al., 2014). Home country refers to the country from which a firm originates or where its headquarters are located whereas host country refers to a foreign country to which production is offshored. Production within the home country may also be referred to as onshore production. The terms offshoring and reshoring are used irrespectively of the ownership mode (Gray et al., 2013). I focus only on location and do not further investigate effects of ownership modes as this case study exclusively deals with out-sourced production. For this reason, whenever discussing offshoring, I implicitly refer to offshore outsourcing.

This chapter will proceed by introducing relevant frameworks from the international business literature. Then, I will describe specific drivers of location decisions with special consideration of the impact of advanced technologies.

2.1 International business frameworks

The international business literature offers various frameworks that can guide location decisions concerning production (Fratocchi et al., 2013). Frequently used frameworks are transaction cost economics, the resource-based view and the OLI framework (e.g. Ellram et al., 2013; Canham and Hamilton, 2013; McIvor, 2013).

Transaction cost economics (henceforth TCE) were introduced by Williamson (1975) and are concerned with the cost of transactions that arise from uncertainty, information asymmetry and opportunistic behavior. Following TCE, firms will choose locations to minimize transaction costs, primarily in form of coordination and uncertainty costs (Johansson et al., 2019; Bertrand, 2011; Rosenbusch et al., 2019).

The resource-based view (henceforth RBV) by Barney (1991) builds on the notion that competitive advantages arise from valuable, rare, inimitable and non-substitutable firm resources. The RBV suggests that firms choose locations for production so that it

can best enhance already possessed resources and capabilities and access new ones (McIvor, 2013). In addition, Peng et al. (2009) and Brouthers et al. (2008) argue that the effectiveness of firm resources is also dependent on the institutional environment, which thus also needs to be considered in location decisions.

The OLI framework by Dunning (1980, 1998) consists of three pillars, ownership, location and internalization advantages (hence the acronym OLI) to explain international production decisions. The author describes four types of motives of location decisions: resource-seeking, market-seeking, efficiency-seeking and strategic asset-seeking motives. Resource-seeking motives concern the access to raw materials as well as complementary factors to enable resource exploitation, e.g., infrastructure. Market-seeking motives can be the access to demand markets or labor markets but also the institutional environment. Efficiency-seeking motives refer to cost factors. Strategic asset-seeking motives include access to local knowledge, synergies and learning.

2.2 Drivers of location decisions

Offshoring and reshoring are fundamentally different decisions as one is the movement away from the home country and the other the complete reverse. Due to different characteristics, I first discuss drivers of offshoring and then of reshoring. While I explore a plethora of drivers, note that not all drivers are relevant in every location decision.

2.2.1 Offshoring

Multiple drivers can motivate firms to offshore production. Figure 1 presents an overview of offshoring drivers proposed in literature. In this subsection, I will only elaborate on the most relevant factors.

Figure 1 – Offshoring drivers in literature

Based on the framework developed by Fratocchi et al. (2016), I structure the drivers reported in literature across two dimensions: the origin of the drivers and the underlying strategic goal. The origin refers to whether the driver arises from the *external environment* or from within the firm (*internal environment*). The strategic goal refers to whether the driver is aimed at decreasing costs (*cost efficiency*) or at increasing the *customer perceived value*. Drivers which I do not explicitly discuss are referenced in this figure. All other references can be found in the main text.

<table>
<tr><th></th><th colspan="2">Internal Environment</th><th colspan="2">External Environment</th></tr>
<tr><td rowspan="4">Customer Perceived Value</td><td></td><td colspan="2">Access to new markets</td><td></td></tr>
<tr><td rowspan="3">Demand proximity
Perceived need to not miss opportunity (Martinez-Mora and Merino, 2014)
Bandwagon Effect
Strengthen offshore relationships (Canham and Hamilton, 2013; Di Gregorio et al., 2009)
Dampen competition (Wu and Zhang, 2014)</td><td rowspan="2">Allows focus on core capabilities (Bernard et al., 2020)</td><td>Quality improvements (Di Mauro et al., 2018)
Lack of skilled labor in home country/Availability in host country
Lack of resources in home country/Availability in host country
Countertrade requirements (Di Mauro et al., 2018)
Foreign market access or development</td><td rowspan="3">Decreased trade barriers (Rosenbusch et al., 2019)
Factor-market rivalry (Tate et al., 2014)
Business-friendly regulations (Wiessmann et al., 2016; Kazmer, 2014; Rosenbusch et al., 2019)
Access to networks/innovation clusters/strategic alliances
Leverage capabilities of foreign suppliers (Di Gregorio et al., 2009; Porter, 1990)
Foreign goodwill (Kazmer, 2014)
Access to local knowledge & learning
Access to technology</td></tr>
<tr><td rowspan="2">Cost Efficiency</td><td>Search for pollution havens to avoid environmental regulations (Gray et al., 2013)
Tax benefits (Kazmer, 2014; Kinkel, 2012; Kinkel and Maloca, 2009)
Converging consumer tastes (Rosenbusch et al., 2019)
Productivity (Kazmer, 2014; Di Mauro et al., 2018)
Labor costs
Production costs</td></tr>
<tr><td>Reduction of communication costs
Economies of scale
Standardized and low skill processes (Kinkel and Maloca, 2009)</td></tr>
<tr><td></td><td colspan="2">Reduction of transport costs (Grossman and Rossi-Hansberg, 2008)
Transfer demand uncertainty to suppliers (Baden-Fuller et al., 2000; McCarthy and Anagnostou, 2004)
Local capacity constraints in home country (Canham and Hamilton, 2013; Kinkel and Maloca, 2009)
Synergies of resources/skills</td><td></td></tr>
</table>

By far the most pronounced factor, especially in the early offshoring waves, are lower production costs that can be achieved by relocating production to developing countries, for example in East Asia. The primary reason for lower production costs offshore

are relatively lower labor costs (e.g. McCarthy and Anagnostou, 2004; Kazmer, 2014; Kakabadse and Kakabadse, 2000; Johansson and Olhager, 2018). Economies of scale offshore enhance this effect by lowering unit costs as around-the-clock shifts and supplier factories serving multiple firms increase the output (Canham and Hamilton, 2013; Pisano and Shih, 2009; Martinez-Mora and Merino, 2014; Roza et al., 2011).

Beyond cost drivers, firms offshore production to access foreign resources. Resources sought after via offshoring include raw materials (Kazmer, 2014; Roza et al., 2011) access to skilled labor (Steinberg et al., 2017; Lewin et al., 2009), access to specific technologies (Baden-Fuller et al., 2000; Kakabadse and Kakabadse, 2000; Rosenbusch et al., 2019) and access to markets (Baden-Fuller et al., 2000; Kazmer, 2014; Kinkel and Maloca, 2009; Di Gregorio et al., 2009; Johansson et al., 2019).

The third major group of motives consists of access to strategic assets as in Dunning (1998). Firms are found to offshore production, seeking local knowledge from suppliers, networks and innovation clusters in foreign countries, to complement their own knowledge and create synergies (Canham and Hamilton, 2013; Kinkel, 2012; Kazmer, 2014; Di Gregorio et al., 2009; Steinberg et al., 2017; Nujen and Halse, 2018; Porter, 1990). Although technologies enable knowledge flows over distance, key process knowledge often takes the form of tacit knowledge, which is locally embedded and cannot be easily communicated. Thus, firms have to interact with local partners to create spillover of tacit knowledge (Roza et al., 2011; Nujen and Halse, 2018; Andersson and Forsgren, 2000). Cantwell (2009) and Bertrand (2011) further remark that absorptive capacity, referring to the ability to identify, internalize and use external knowledge (Cohen and Levinthal, 1989), is also necessary to enable such learning.

Lastly, offshoring decisions can also be subject to decision biases and are thus not always rational. External pressure exercised by competitors can result in hasty and unplanned decisions (Wiessmann et al., 2016; Baden-Fuller et al., 2000; Martinez-Mora and Merino, 2014). Similarly, the bandwagon effect may induce firms to imitate the offshoring strategy of others without intrinsic motives (Nujen and Halse, 2018).

2.2.2 Reshoring

As for offshoring, I present an overview of reshoring drivers in Figure 2. Note that I will omit Industry 4.0 as a driver for now, which I will discuss in-depth in the next section.

First, the erosion of labor cost advantages of production in East Asia due to the assimilation of wage levels is cited as a key reason to reshore production (e.g. De Backer et al., 2016; Ellram et al., 2013; Fratocchi et al., 2014; Kinkel, 2012; Manning, 2014; Whitfield, 2017). Further costs associated with offshore production that drive reshoring include transport costs due to long transports from Asia to key markets in Europe, rising fuel costs and lack of competition among shipping providers (Behar and Venables, 2011; Wu and Zhang, 2014). The long lead times also result in high inventory costs as safety stock and in-transit stock increase proportionally to lead time (Bailey and De Propris, 2014; Tate et al., 2014; Wiessmann et al., 2016). Further, high coordination costs for controlling and monitoring offshore production can drive the reshoring (De Backer et al., 2016; Kinkel and Maloca, 2009; Steinberg et al., 2017).

Beyond costs, other labor market factors are shown to drive reshoring decisions including labor availability (Ellram et al., 2013; Kinkel, 2012; Kinkel and Maloca, 2009; Tate et al., 2014), labor turnover and inadequate work attitudes in the host country (Canham and Hamilton, 2013; Tate and Bals, 2016). Various studies also find quality

Figure 2 – Reshoring drivers in literature

I structure the reshoring drivers reported in literature via the same framework as the offshoring based on Fratocchi et al. (2016). Again, references are only indicated for those drivers not explained in the main text.

<table>
<tr><th></th><th colspan="2">Internal Environment</th><th colspan="2">External Environment</th></tr>
<tr><td rowspan="3">Customer Perceived Value</td><td></td><td colspan="2">Sustainability (Ellram et al., 2013; Tate, 2014)
Lead time impact</td><td></td></tr>
<tr><td rowspan="2">Automation/Industry 4.0
Restructuring towards lean (Ellram et al., 2013)
Low trust in foreign operations (Wiessmann et al., 2016)
Demand proximity
Mitigate supplier dependence (Nujen et al., 2018)
Termination of supply relations (Di Mauro et al., 2018)
Bandwagon effect
Hassle factor (Schotter and Beamish, 2013)
Need for turnaround (Baily and De Propris, 2014)
Correction of misguided decision
Mitigate unintended strategic costs of offshoring (e.g., skill gaps, innovation lags) (Whitfield, 2017)
Change of business strategy</td><td>Home bias
Patriotism/Loyalty/Sense of belonging
Innovative products (Fisher, 1997)
Responsiveness
Flexibility
Innovation and R&D proximity
Refocus on core activities (Stentoft et al., 2016)</td><td>Availability of resources (Tate et al., 2014)
Availability of labor
Working attitude in host country
Poor manufacturing quality
Positive image effects of reshoring (Grappi et al., 2015)
Domestic goodwill (Wiessmann et al., 2016)
Made-in Effect / Willingness to pay/buy
Changing demand patterns (Dachs et al., 2019; Martinez-Mora and Merino, 2014)
Shortened lifecycles
IP risks
Access to knowledge
Enable process knowledge transfer (Kinkel and Maloca, 2009)
Access to technology</td><td rowspan="3">Resource competition in host country (Wiessmann et al., 2016)
Global SC risks (e.g. shortages, disruption)
Political risks (Manning, 2013)
Trade policies (Ellram et al., 2013)
Government incentives & policies (Tate, 2014; Tate et al., 2014)
Global/local economic changes/downturns (need to reevaluate) (Tate, 2014)</td></tr>
<tr><td>High inventory (in-transit & safety stock)
Penalties for late orders
Coordination costs
Communication costs
Bureaucracy & administrative costs</td><td>Tariffs (Martinez-Mora and Merino, 2014)
Productivity gains
Labor turnover in host country
Energy costs (Stentoft et al., 2016; Ancarani et al., 2019)
Eroding labor cost advantages
Currency/Exchange rate risk (Ellram et al., 2013; Baily and De Propris, 2014; Tate et al., 2014)
Lack of infrastructure in the host country (Kinkel and Maloca, 2009; Manning, 2013)
Cultural distance (Manning, 2013; Steinberg et al., 2017)</td></tr>
<tr><td>Cost Efficiency</td><td></td><td colspan="2">Transport costs
Idle capacity at home (Tate, 2014)
Union’s pressure in home country (Di Mauro et al., 2018)</td><td></td></tr>
</table>

issues in offshore production among the most common motives to reshore (e.g. Bailey and De Propris, 2014; Canham and Hamilton, 2013; Tate et al., 2014).

As for offshoring, co-location to key partners can be a goal of reshoring (De Backer et al., 2016). Firms may reshore production to access specific knowledge clusters or technologies (Kinkel, 2012; Johansson and Olhager, 2018). In addition, firms traditionally offshore production as a non-core activity while locating research and development (R&D) in the home country. However, innovation and production processes are not independent from each other but intertwined. Hence, a key reshoring motive proposed in literature is to co-locate R&D and production to accelerate innovation (e.g. De Backer et al., 2016; Arlbjorn and Mikkelsen, 2014; Pisano and Shih, 2009; Kinkel, 2014; Whitfield, 2017).

Further motives relate to responsiveness. Offshoring is typically related to long lead times due to shipping. Therefore, production planning has to occur well before products reach the market and firms can only adjust production to changing demand patterns inflexibly. This issue is further augmented for products with inherently high demand volatility, high product variety or short lifecycles. Hence, firms may choose to reshore production to enable proximity to key markets to reduce lead times and increase responsiveness (e.g. Arlbjorn and Mikkelsen, 2014; Kinkel and Maloca, 2009; Yao and Minner, 2017; Tate et al., 2014; Boute et al., 2020; Fisher, 1997; McIvor, 2013; Wu and Zhang, 2014).

Various risk factors can induce firms to reshore production. Global supply chains – the result from offshoring – inherently carry distinct risks. With the length of the supply chain, the likelihood of disruptions (Bailey and De Propris, 2014; Wiessmann et

al., 2016; Ellram et al., 2013), the fluctuation of lead times and the risk of shortages increase (Tate, 2014; Martinez-Mora and Merino, 2014). Further, intellectual property protection is typically less legally enforceable in host countries than in the home country (De Backer et al., 2016; Tate, 2014; Baily and De Propris, 2014; Steinberg et al., 2017).

Reshoring can also affect consumer behavior. Grappi et al. (2015) find that producing products in the home country increases both the consumers' willingness to buy and pay due to what is coined as the made-in effect, i.e., the preference for goods produced in the home country.

As for offshoring, decision biases can affect reshoring. As more firms choose to reshore production, other firms may imitate this strategy – referred to as bandwagon effects (Gray et al., 2013; Fratocchi et al., 2013). Simultaneously, reshoring decisions also potentially suffer from the well-known home bias (Obstfeld and Rogoff, 2000) induced by patriotic feelings or a sense of belonging (Canham and Hamilton, 2013; Di Mauro et al., 2018). However, a home bias can also be induced by more tangible factors like the familiarity with the environment (Fratocchi et al., 2013).

Finally, reshoring has to be seen in conjunction with the previous offshoring (Kinkel and Maloca, 2009; Tate and Bals, 2016). Three competing explanations exist in literature why firms may reverse the previous offshoring decision by reshoring. First, a change of exogeneous factors, e.g., rising wages, may induce reshoring (Fratocchi et al., 2013, 2014; Martinez-Mora and Merino, 2014). Second, the managerial valuation can change irrespective of exogeneous changes. Di Mauro et al. (2018) reason this with a change of the competitive strategy of the firm. As a firm shifts from a low-cost strategy to a focus on quality, factors such as labor costs might be weighed less than

before in location decisions. Third, reshoring can be a correction of flawed offshoring decisions caused by biases, insufficient information about the location or wrong estimations, e.g., regarding cost savings (De Backer et al., 2016; Kinkel and Maloca, 2009; Canham and Hamilton, 2013; Nujen and Halse, 2018).

Having discussed the drivers of reshoring, I want to briefly draw attention to distinct challenges of reshoring. Earlier, I explored the embeddedness of knowledge in the host country which is only accessible via frequent interactions with local partners. When reshoring production, firms risk to lose such knowledge. Further, when offshoring production to foreign suppliers, firms tend to lose internally developed manufacturing capabilities over time, referred to as hollowing out, which may pose a barrier to later reshoring attempts (Whitfield, 2017; Steinberg et al., 2017; Nujen and Halse, 2018).

2.3 Industry 4.0 and location

Given the purpose of this study, previous research on the role of advanced technologies in location decisions is particularly relevant. Firstly, I will depict current major technological advances which impact production. Following Strange and Zucchella (2017), the main advances in manufacturing are big data analytics, the internet of things (IoT), robotization and additive manufacturing. Big data analytics refers to the use of large and diverse sets of data for descriptive, predictive and prescriptive analysis. IoT means the digital interconnection of physical objects, e.g., machines. Robotization is the physical interaction of machines with their environment. Additive manufacturing, commonly known as 3D printing, is a technique to form products layer-by-layer, e.g., by fusing small particles via lasers. Further supporting innovations include digital visualizations, real-time control, simulations, artificial intelligence and automation. Combinedly, these technologies form what is known as Industry 4.0 (I4.0), referring to the fourth industrial revolution (De Backer et al., 2018; Ancarani et

al., 2019; Biswas, 2018, p. 137). The product of I4.0 are innovative production facilities which produce goods largely independently from human inputs using the above technologies (Ilankovic et al., 2020; Tate and Bals, 2016; Dachs et al., 2019).

Traditionally, technologies have been primarily associated with the reduction of coordination costs which enables offshoring following TCE (Dachs et al., 2019). However, several research studies find a direct effect of the adoption of I4.0 technologies on the likelihood to reshore production (e.g. Tate and Bals, 2016; Nujen et al., 2018; De Backer et al., 2016, 2018; Tate, 2014; Arlbjorn and Mikkelsen, 2014). By enabling automated production, manufacturing becomes less labor intensive, reducing labor costs irrespective of location. Consequently, labor costs are less relevant for location decisions with I4.0 technologies, which allows firms to focus on achieving other strategic goals such as demand proximity and thus enables reshoring (Attaran, 2017; Ancarani et al., 2019; Laplume et al., 2016; De Backer et al., 2018). Furthermore, I4.0 technologies drive production speed and responsiveness via automation, rapid prototyping, flexible processes and reduced process complexity. Since speed and responsiveness can be key motives of reshoring strategies, I4.0 technologies are a highly complementary tool help to achieve this goal and hence can support the reshoring decision (Attaran, 2017; Dachs et al., 2019; Sodhi and Tang, 2017).

3 Methodology

The purpose of this study is to determine effects of innovative production facilities on location decisions. Therefor, I employ a single case study method following Yin (2018) to explore the Adidas Speedfactory to derive insights on the research topic.

The case study method was chosen because the emergence of I4.0-driven innovative production facilities is a very contemporary phenomenon. Large-scale datasets are not

available yet, since only very select state-of-the art factories like the Adidas Speedfactory exist (Jahns, 2018; Ritzer, 2019). Simultaneously, the complexity of location decisions as outlined by the multitude of potential factors demands the holistic examination of location decisions within their context, which a case study enables. Furthermore, the case study method allows to research the Speedfactory as a longitudinal case to reveal shifts over time.

I chose the Adidas Speedfactory as the focal case due to two characteristics: its theoretical criticality and its extremeness (Yin, 2018, pp. 84-85). The Speedfactory is a case highly critical to the researched issue as it perfectly fits the definition of an innovative production facility by employing a plethora of advanced technologies (Ilankovic et al., 2020) and was relocated recently (Adidas, 2019d). Concurrently, the Speedfactory is an extreme case. It serves as a prime example of innovative production facilities while other factories comparable in innovativeness and scale are scarce, especially in the footwear industry (Henkel, 2016; Biswas, 2018, p. 136; Ritzer, 2019). Hence, the relocation of this one-of-a-kind factory marks an unprecedented event worth studying in-depth.

The case study methodology builds on inquiring into a multitude of sources during the data collection. This allows for different perspectives to be incorporated so that the actual case developments can be determined via triangulation (Yin, 2018, p. 46). While this paper analytically focuses on the location decisions in the case, all case developments are relevant to establish the context of the decisions. I structured the data collection around the following guiding questions: *Which technologies were used in the Speedfactories? How was the Speedfactory implemented into the existing organization and supply chain? How was the business model parameterized, how did it evolve? What caused the stopping of the project in Germany and the transfer to Asia?* Based

on this initial set, I developed further detailed questions and extended the list during data collection as the case narrative evolved or gaps were revealed. The complete list is found in the appendix in List 1.

Initially, I identified sources via Google searches using the key words "Adidas Speedfactory". Further sources were found by following links in obtained sources. During the process of data collection, I conducted additional Google searches targeted at specific questions on the aforementioned list as needed. Simultaneously, I screened the Adidas' corporate website for press releases connected to the case and for publications including annual reports. In addition, I searched Adidas' blog "GamePlan A" for posts linked to the Speedfactory. Lastly, I searched for academic papers discussing the Speedfactory via Google Scholar, albeit no papers identified this way contributed notable insights. All data was collected from October to December 2020.

Furthermore, I established a contact to Adidas via the alumni network of the CEMS Global Alliance. Thereby, I was indirectly referred to a manager involved in the Speedfactory project from the beginning. With this contact, I conducted a semi-structured interview lasting one hour in early December 2020. The interview was held in German to accommodate the preference of the interviewee and was recorded and later transcribed. Due to firm internal restrictions, the interviewee will be anonymized as Interviewee A when referenced and the transcript will not be contained in this paper. I used a semi-structured method (Drever, 1995; Leech, 2002), using only a short list of prepared questions (see List 2 in the appendix) while also giving enough freedom to the interviewee to report his view of the project. Therefore, major parts of the interview consisted of the interviewee freely elaborating on the Speedfactory with additional ad-hoc queries posed by the interviewer.

I obtained a total of 202 sources from which I constructed the case narrative. The sources can be classified as follows: one interview with an Adidas employee, 30 press releases by Adidas, 20 published documents such as annual reports, two patents by Adidas, seven Adidas webpages, seven blog posts on GamePlan A, two Youtube videos by Adidas, 13 publications by Adidas' partner Carbon, seven publications by Adidas' partner Oechsler, seven publications by further partners, six externally provided statistics and lastly 100 third-party articles, mostly in online magazines. To triangulate the actual case developments, I relied on the convergence of multiple sources. Furthermore, the final case narrative was reviewed by Interviewee A for correctness.

On the basis of the collected data and the conducted literature research, I analyze the case with the goal of analytical generalization. In contrast to statistical extrapolation, this refers to the confirmation or modification of existing theories or the generalization of new ones (Yin, 2018, p. 53). I use the drivers of location decisions identified in the previous section and hypotheses presented in the case sources as potential rivaling explanations of the developments to conduct pattern matching (Yin, 2018, pp. 224-228). By matching the observations from the case to existing theories, I try to enhance the understanding of location decisions with innovative production facilities. Lastly, I follow a grounded theory approach (Charmaz, 2003) to build any missing explanations from the ground up via thorough data analysis.

4 The Adidas Speedfactory

Adidas opened the so-called Speedfactory in Germany in 2015 and closed it again less than five years later (Adidas, 2015c, 2019d). As a basis for the analysis with regards to the research questions, I depict the developments around the Speedfactory in this chapter. To enable the full understanding of the present location decisions and the Speedfactory as an innovative production facility, a detailed view of the case is

required. Therefore, this chapter will holistically explore the Speedfactory and not only the actual location decisions.

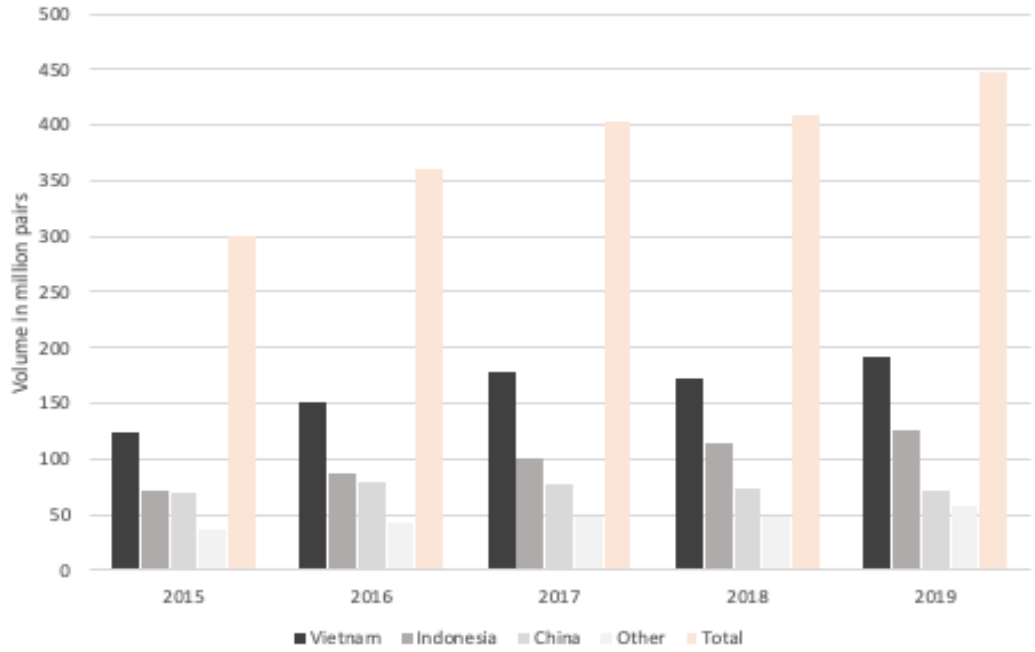
4.1 Status quo

Adidas is among the world's leading producers of sports and sports lifestyle products with recently over 23,000 billion € in annual sales (Adidas, n.d. e). This case is primarily concerned with Adidas' footwear segment, which has consistently been the firm's largest source of revenue throughout the last decade (Statista, 2020a). Footwear products include sneakers and performance shoes, i.e., running shoes and shoes for specific sports. To comprehend the innovations introduced by the Speedfactory, I first will depict Adidas' standard production processes.

During the 1980s, Adidas offshored the majority of their production to suppliers in East Asia – China in particular – in order to reduce production costs by accessing low-cost labor (European Reshoring Monitor, n.d.; Reference for Business, n.d.; Manthorpe, 2017; Ritzer, 2019). When closing the last onshore production site in 1993, Adidas effectively diverged from being a manufacturing company and to instead focus on core activities such as R&D and marketing (Reuters, 2016; Manthorpe, 2017). Since then, production was handled by a network of subcontracted firms, i.e., suppliers, that each specialize in the production of specific shoe components. The components are shipped from one supplier factory to the next, where the next component is added until the entire shoe is assembled. Thus, production is dispersed across a multitude of firms and countries including Vietnam, Indonesia and China. The finished products are transported to a distribution center in China from which they are shipped to the target markets (Adidas, 2018a; Interviewee A, personal communication, 10 Dec 2020; Manz, 2016; Bain, n.d.). Hence, when speaking of Adidas's offshore production, I will implicitly mean the outsourced production of the suppliers. Currently, the

network consists of 127 tier one suppliers for the footwear segment (Adidas, 2020a). Figure 3 shows an overview of Adidas' footwear production by country in the past five years. This figure reveals the result of a recent trend. Primarily due to rising wages in China, major footwear producers including Adidas, steadily shift production to other low-cost countries, especially Vietnam, where average wages are currently only a quarter of those in China (Bain, 2018; World Data, 2019; Wolf, 2018, Statista, 2020b). Additionally, note that Adidas also sources production from countries outside of Asia but this is neglectable due to the low volume as Europe and the Americas combine for less than 5%. I will refer to the production process depicted above as the traditional process in the following sections.

Figure 3 – Adidas' footwear production by country from 2015 to 2019



Based on data from Adidas (2016b, 2017a, 2018a, 2019b, 2020b).

Adidas' current production model has three main implications. First, the production via the supplier network is time-consuming. Adidas's production lead time is estimated at two to three months (Weiss, 2017; Manthorpe, 2017). On top of this, the shipping of finished products to the target markets takes over 40 days on average

(Wardlaw, 2016; Adidas, 2016c). Thus, the process from placing orders to having the products in the target market can take over 100 days. Second, footwear production involves a high degree of manual labor as many processes are difficult to automate due to specific attributes of the materials (Interviewee A, personal communication, 10 Dec 2020). Third, the product development process is slow. The process of designing and testing products, preparing production, producing and shipping takes a total of around 18 months for Adidas (Interviewee A, personal communication, 10 Dec 2020; economist 14.1.17). Concurrently, fashion cycles are sped up by the e-commerce and social media trends so that they are barely longer than the product development process (Bain, n.d.; Wiener, 2017).

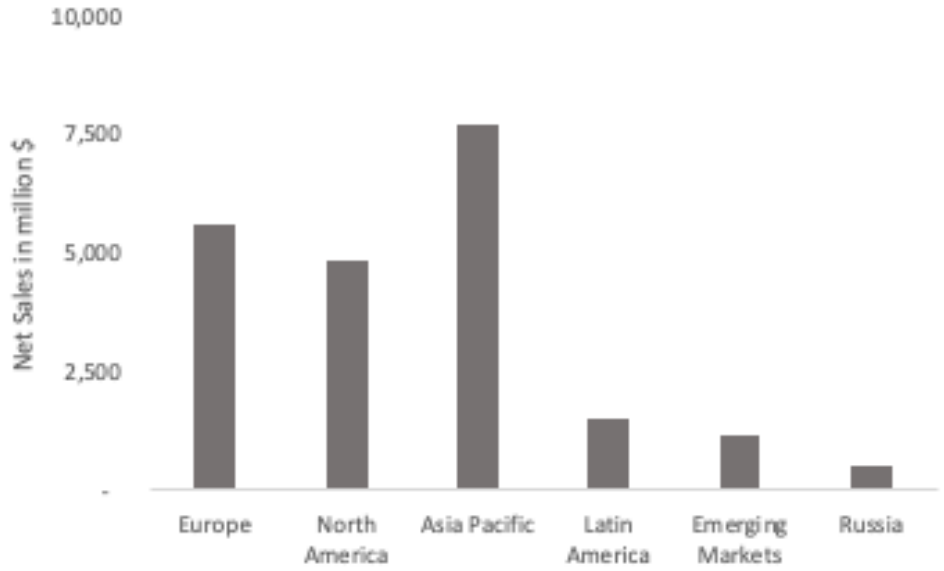
4.2 Initial idea of the Speedfactory

Due to these shortcomings of the traditional production, Adidas' "Future Team" started developing the idea around 2013 that later grew into the Speedfactory. This initial idea revolved around one key goal: increasing speed drastically, hence the name Speedfactory. Adidas planned to speed up production within factories by automating and robotizing all main process steps (Interviewee A, personal communication, 10 Dec 2020). At first, Adidas therefore developed new manufacturing processes individually and later generated the idea of joining all these processes into one new factory, i.e., the Speedfactory (Manthorpe, 2017).

With this idea of the Speedfactory as an automated, high-speed production facility, key advantages of the envisioned Speedfactory over the previously described traditional production model became apparent to Adidas. Beyond speed advantages, automation could reduce the need for low labor costs by reducing the manual labor input. Hence, the Speedfactory could be placed anywhere in the world regardless of labor cost levels allowing for the production in proximity to key markets (an overview of

Adidas' markets is presented in Figure 4), which, even more than automated production processes, results in drastically increased speed by reducing transportation times. Simultaneously, Adidas envisioned that the concentration of automated production processes in one factory would allow for the drastic reduction of the time needed for product development. Further benefits could arise from the flexibility to produce in small volumes for local markets only, which lowers costs and disruption risks (Interviewee A, personal communication, 10 Dec 2020).

Figure 4 – Adidas' sales by market in 2019



Based on Adidas (2020c).

Convinced by these potential advantages, Adidas chose to realize the Speedfactory project by opening a pilot Speedfactory in Ansbach, Germany, close to Adidas' global headquarters, on December 9, 2015 (Adidas, 2015c). The costs of this pilot are undisclosed but one source estimates a range of two to ten million € (Manthorpe, 2017) while further research funds were given to Adidas by Germany's federal government (Henkel, 2016; Ritzer, 2019). The top management gave these funds to the Future Team on the condition to start production within two years (Manthorpe, 2017). The pilot was set up together with the German polymer processing company and

automation expert Oechsler, with whom Adidas had already been collaborating before, as Adidas themselves lacked the necessary manufacturing capabilities since they had outsourced production for the past decades. First conversations with Oechsler regarding the Speedfactory took place in mid 2014 (Adidas, 2015c, 2016c, 2017c; Manz, 2016).

With the opening of the pilot Speedfactory, Adidas not only followed the idea of then CEO Herbert Hainer of bringing production back to Germany (Hancock, 2017) but also engaged in a larger vision. Various documents by Adidas (Manz, 2016; Adidas, 2016b, 2017a) as well as quotes by Herbert Hainer (Reuters, 2016), James Carnes, Vice President of Strategy Creation (Adidas, 2016e) and Gerd Manz, Head of Technology Innovations (Adidas, 2015c; Bain, n.d.) underline Adidas' initial intention to create a global network of Speedfactories in the long-run, each serving local markets, and eventually to even produce directly in-store (Adidas, 2015c, 2016c).

4.3 Speedfactory technologies

As the traditional shoe manufacturing process was largely performed manually, the core challenge in the implementation of the Speedfactory was that the envisioned automated machines first had to be invented (Interviewee A, personal communication, 10 Dec 2020; Bain, n.d.; Henkel, 2016). Nonetheless, Adidas could adopt some machines from other industries, albeit these required specific modifications to fit Adidas' needs (Adidas, 2017c). The development process consisted of two steps, first mechanical inventions were needed, i.e., machines that physically perform the tasks, and second the interconnection of machines through digital innovations was desired. Due to lack of manufacturing knowledge of Adidas as they had not produced shoes themselves since outsourcing to Asia in the last century, Adidas chose to develop the machines in cooperation with external partners. During this process, Adidas' key

principle was to not be restricted by the traditional production processes but instead to challenge all assumptions by building new processes from the ground up. As a result, Adidas developed at least seven new machine prototypes and then digitally unified the individual processes (Interviewee A, personal communication, 10 Dec 2020).

The following description of the distinct process steps is largely based on an analysis by Solereview (2017) of a video by Adidas depicting the processes inside the Speedfactory. As an additional note due to common misconception, 3d printing was not initially part of the Speedfactory and was only added later (Interviewee A, personal communication, 10 Dec 2020). Therefore, I will discuss 3D printing separately in a later section.

Initially, the products are designed digitally (Wiener, 2017). Then, the shoe soles and the upper – the top part of the shoe commonly made out of textile or leather – are produced in parallel. The sole consists of two parts: an outsole and a midsole. The outsole is a small layer at the bottom of the shoe created from rubber via injection molds (Ilankovic et al, 2020). The midsole is the larger and more visible part of the sole. For the Speedfactory shoe models, Adidas chose to use their, at the opening of the Speedfactory most advanced, midsole technology called Boost (Interviewee A, personal communication, 10 Dec 2020) based on a material called Infinergy expanded thermoplastic polyurethane (e-TPU) developed by BASF (Woolf, 2018; The Fashion Law, 2017; Manthorpe, 2017). White granules of e-TPU in molds are fused into the Boost sole via high pressure and temperature by a particle foaming machine, called Boost Foamer, by Kurtz Ersa (Solereview, 2017; Kurtz Ersa, 2016). Due to the involved heat, the midsoles are then retrieved by robotic arms provided by Kuka (Solereview, 2017; Wiener, 2017; Smith, 2019).

The upper is created from a specifically engineered fabric, which is knit by machines into the material that Adidas calls Primeknit. This knit fabric is further processed along production lines provided by the engineering firm Manz (Reuters, 2016; Manz AG, 2016). The shape out of which the upper can later be formed is laser-cut out of the two-dimensional fabric. Guided by optical sensors, robotic arms stick strips of thermoplastic polyurethane to the fabric to later provide stability and for the brand-characteristic three stripes. These strips are then fused to the fabric via lamination. Out of this preprocessed two-dimensional fabric, the upper is formed via stitching, which is still partly done manually. The formed upper is brought to a machine pressing the back part of the shoe to the upper guided by lasers (Solereview, 2017; Smith, 2019; Wiener, 2017; Manz, 2015a, 2015b).

While traditionally upper and sole are manually glued together, the Speedfactory uses a process called Fuse Bonding which welds upper and sole together via lasers and optical sensors. Thus, the precision of the fusing is enhanced while the abandonment of adhesives saves time for solidification, reduces the shoe weight and is environmentally friendlier (Solereview, 2017; Manthorpe, 2017; Adidas, n.d. b, 2016e, 2017c). Finally, the laces are manually inserted into the shoes and the shoes are packed into boxes by workers. These details remain manual as Adidas did not prioritize them while specifically inserting the laces also appears difficult to automate (Interviewee A, personal communication, 10 Dec 2020; Henkel, 2016).

Beyond the depicted core processes, several digital technologies further enhance the Speedfactory. QR codes on every part allow for constant quality control and the tracing of mistakes (Bain, n.d.; Manthorpe, 2017). Additionally, Adidas partnered with Siemens in 2017 to build a digital twin of the Speedfactory, enabling the simulations to

optimize the processes (Adidas, 2018a; Bain, n.d.). Lastly, technology by Aramis enables the integration of athletes' data into the product designs (Adidas, 2016e).

The result from these process innovations is increased quality, driven by accuracy and consistency, and speed due to the automated and simplified process (Bain, n.d.; Adidas, 2015c, 2016b). The Speedfactory uses only one polymer type throughout the shoe and ten times less components per shoe. For illustration, the Speedfactory process forms the upper from a single piece of fabric which is not the case in the traditional process (Interviewee A, personal communication, 10 Dec 2020). However, the Speedfactory process also faces a distinct challenge regarding the production of different shoe types. To produce the different models in Adidas' portfolio, different kinds of processes and machines would be needed, e.g., Fuse Bonding cannot be used to join leather uppers to soles. This issue has only been solved in part until today. Hence, Adidas chose to only produce one product type in the Speedfactory in the beginning and opted for mass customization, meaning the customization of products to entire communities, rather than the ultimately envisioned personalization (Interviewee A, personal communication, 10 Dec 2020; Adidas, 2016c; Smith, 2019).

4.4 Scaling of the Speedfactory

In 2015, Adidas launched a new corporate strategy for the next five years dubbed "Creating the New". This strategy builds on three main goals: speed, cities and open source. Open source here means the collaboration with external partners. The cities component rests on the idea that key cities influence consumers globally. Adidas identified six cities, New York, Los Angeles, Paris, London, Tokyo and Shanghai, in which the firm wanted to stimulate growth. The Speedfactory directly tied into this "Creating the New"-strategy as a vehicle to drive all three goals (Adidas, 2016c, 2016d).

Consequently, the ideas of speed, cities and open source will reappear throughout this case and can explain strategic choices regarding the Speedfactory.

Upon opening the pilot, Adidas developed the Speedfactory concept, which initially focused on production only, into an end-to-end business model. Thus, the Speedfactory had its own brand- and product-level planning and marketing while also decisions concerning logistics and distribution were made independently from the remaining supply chain. Adidas also chose to actively market products from the Speedfactory by referring to where and how they are produced due to positive effects of the origin story of the products on consumers (Interviewee A, personal communication, 10 Dec 2020; Wiener, 2017). The roll out plan for this new concept of the Speedfactory consisted of three phases. In the initial phase, the proof of concept, Adidas planned to sell 500 shoe pairs produced in the pilot Speedfactory to validate the fundamental idea. In the second phase, Adidas wanted to prove the scalability of production volume by producing 100,000 pairs from two Speedfactories in 2017 before then proving the scalability of the business model in 2018 and producing over one million pairs per year. In the third phase, Adidas envisioned the complete commercialization by further scaling in volume through opening additional Speedfactories and the personalization of shoes (Manz, 2016). Adidas planned to also set up future Speedfactories with their partner Oechsler. Simultaneously, Adidas already used the Speedfactories to leverage Asian suppliers into lowering prices (Interviewee A, personal communication, 10 Dec 2020).

In practice, the first phase of this plan culminated in the release of the Adidas Futurecraft M.F.G. (standing for made for Germany) exclusively for the German market for 250 € on September 21, 2016 as the first shoe from the Speedfactory (Adidas, 2016e; Interviewee A, personal communication, 10 Dec 2020). Thus, within only 9 months after opening the pilot Speedfactory, the first product, albeit a limited edition, was

launched to the public. All 500 pairs of the Futurecraft M.F.G. sold out instantly, with buyers having camped outside the store awaiting the release (Wiener, 2017; Weiss, 2017). Simultaneously, Adidas reports a production time of few hours per pair (five hours according to Bissell-Linsk (2017)), indicating a significant improvement compared to weeks of production time in Asia (Adidas, 2017c). On this basis, the proof of concept has to be regarded as a success while the customer demand also gave Adidas positive feedback on the market readiness of the product.

At the same time, this first product also foreshadows several of Adidas' decisions regarding subsequent products from the Speedfactory. First, the Futurecraft M.F.G. serves as the role model for following Speedfactory models as subsequent products have the same basic outline and product features (see Figure 7 in the appendix for an image comparison). Additionally, the Futurecraft M.F.G. reveals that Adidas decided to use the Speedfactory to produce high-performance running shoes at respectively high prices. This choice is reasoned by the high production costs due to the use of yet immature processes and advanced technologies (Interviewee A, personal communication, 10 Dec 2020). Concurrently, these high prices did not deter demand while resell values of several Speedfactory models were even above the original retail price (e.g. StockX, 2021d, 2021i, 2021l). Lastly, this first model also shows Adidas' strategy to use the Speedfactory for localized products and "for moments that matter" (Adidas, 2019d). The Futurecraft M.F.G. running shoe was released specifically prior to the Berlin Marathon (Adidas, 2017c).

During the production of the Futurecraft M.F.G., Adidas already heralded the start of phase two of the roll out plan. In May 2016, the firm announced the full launch of the Speedfactory for the second half of 2016 by transferring the pilot Speedfactory to a larger facility in Ansbach, which was completed by July (Adidas, 2016a, 2016d; Manz,

2016). This new facility was owned and operated by Oechsler, who also were responsible for sourcing materials, with a total of 160 employees (Murphy, 2017; Interviewee A, personal communication, 10 Dec 2020). With initially three production lines on an area of over 4,000 square meters, the total capacity limit was set to 500,000 shoe pairs annually, to be reached by 2018 by adding further production lines (Adidas, 2017c; Manz, 2016; Interviewee A, personal communication, 10 Dec 2020). The start of serial production was announced for the third quarter of 2017 with a target of producing 50,000 pairs in 2017 (Adidas, 2017a).

Concurrently, Adidas also revealed its plans for setting up a second Speedfactory in the US close to Atlanta, due to the US being the largest market for sporting goods with over 30% of global sales (Manthorpe, 2017; Adidas, n.d. f; Statista, 2019). Thus, a Speedfactory in this market could create new growth opportunities. The Atlanta facility featured the same processes and capacity as the first Speedfactory while also being operated by Oechsler[1]. Thus, the total capacity from both facilities was one million pairs annually. The production start in Atlanta was planned for late 2017 (Adidas, 2016a, 2016f).

As part of the Speedfactory plan, Adidas began to test in-store production and personalization, which was envisioned to be joined with the Speedfactory concept in the future, by opening the pop-up store factory "Knit For You" in Berlin from late 2016 to March 2017. There, customers created sweatshirt-designs for 200 € which were than directly knitted in-store (Adidas, n.d. c; Müller, 2017; Preuss, 2017; Interviewee A,

[1] Interestingly, Oechlser also mentions one of its factories in Vietnam, opened in 2017, in conjunction with its facilities in Atlanta and Ansbach, i.e. the two Speedfactories. While no information by Adidas about this factory is available, Oechsler states that they also produce Boost midsoles for Adidas using I4.0 technology in this factory (Oechsler, n.d. e; Oechsler, 2020). This suggests a potential but unconfirmed connection to the Speedfactory case and possibly first evidence of technology transfer back to Asia. It is unclear why Adidas chose to not disclose any information regarding this factory.

personal communication, 2020). While the store factory did not feature footwear products as apparel was deemed easier to personalize (Interviewee A, personal communication, 10 Dec 2020), the learnings transposed to the Speedfactory concepts.

Phase two of the role out plan reached consumers when Adidas launched its shoe series AM4 (short for Adidas made for) from the Speedfactories in October 2017. Adidas announced six initial models of this series each targeted at one of the key cities identified in the "Creating the New"-strategy. On October 19, 2017, the AM4LDN was launched for London in limited quantities as the first full model from the Speedfactory. The AM4PAR for Paris followed one week later and the other four city editions throughout 2018. Upon the launch of the Atlanta Speedfactory in late 2017, the AM4 models were each primarily produced by the respectively local or closest Speedfactory, i.e., the AM4NYC (New York) and AM4LA (Los Angeles) were mainly produced in Atlanta (Adidas, 2017b, 2018a; Murphy, 2017). The AM4 series also further illustrates the aforementioned customization to communities. While the different AM4 models are largely identical, each model features a distinct design while some properties were tailored to city in collaboration with selected local consumers. For instance, the AM4LDN exhibits higher water-resistance due to the rainy weather in London (Goldhagen, 2017; Adidas, 2018a; Weiss, 2017). According to the plans to further scale the Speedfactory business model, Adidas launched a variety of AM4 models as limited editions throughout 2018 and 2019 including further models for specific cities, collaborations with artists and models for certain events (Adidas, 2019b). Starting with the AM4LDN, Adidas released a total of at least 45 different AM4 models. An overview of all AM4 releases is presented in Table 1 in the appendix.

4.5 Evolving business model

James Carnes, Vice President of Strategy Creation at Adidas, described the Speedfactory business model as very distinct from Adidas' other operations with a demand-led proposition as the key feature (Bain, n.d.). In stark contrast to the traditional bulk production to-stock, the Speedfactory focused on on-demand production in small batches. Hence, the entire business model was built on speed (Manz, 2016; Adidas, 2017c, 2019b; Bain, n.d.). and Adidas reached high production speeds accordingly. Simultaneously, the Speedfactory technologies reduced the time needed for new product developments from over 18 months to initially five months, while smaller adjustments to trends were now possible within a month instead of twelve (Manz, 2016). By the end of 2018, the firm reported a total time from creation to availability to the customer of a mere 14 days for the then current AM4 models (Adidas, 2018d). However, due to the similarities between the AM4 models, only the color design and minor details needed to be newly created whereas the raw show model was pre-made. Thus, the 14 days innovation cycle cannot be compared to traditional product development. Additionally, not all models were created as quickly, for example the AM4 edition celebrating the Toronto Raptor's NBA title was only released five months after the championship (Chin, 2019). Nonetheless, the speed and innovative processes resulted in the public recognition of the Speedfactory as a revolutionary project (e.g. Ritzer, 2019; Smith, 2019) as well as the awarding of the German Innovation Prize to Adidas (Jahns, 2018).

Over the depicted course of events, the central KPIs of the Speedfactory changed. While initially Adidas' Future Team was free to drive innovation in the Speedfactory with the only goal of increasing speed, profitability became an increasingly important factor. According to Interviewee A, profitability and cost KPIs were introduced for the

Speedfactory as Kasper Rorsted succeeded Herbert Hainer as CEO in October 2016. Thus, the high costs of the still young processes now partly outweighed the rather intangible benefits of the original vision. To save costs, machines used in the traditional production processes – it remains unclear which exactly – were re-introduced in the Speedfactory where unsolved challenges remained, thus going against the original principle to avoid constraints of the traditional manufacturing world. Consequently, the new cost-based view transformed the Speedfactory into a compromise between the new and the traditional manufacturing processes. While this deaccelerated innovation within the Speedfactory, it also enabled faster scaling as less machine prototypes were now used (Interviewee A, personal communication, 10 Dec 2020).

Following this change of priorities in the Speedfactory strategy, Adidas began to diverge from the original vision of a distributed network of Speedfactories in local markets. CEO Kasper Rorsted publicly expressed first doubts regarding this vision in 2017, saying that he does not believe in full automation within the next years and that therefore Asia would remain central to production. Moreover, he already hinted at the transfer of Speedfactory technologies back to suppliers in Asia (Hancock, 2017). Hence, the new strategy focused on transferring insights from the Speedfactory to Asia parallel to operating the Speedfactories, effectively making them a test bed to optimize the processes in Asia (Adidas, 2018a, 2019b; Bain, n.d.; HG Tom, 2018). Ultimately, these developments culminated in the closing of the Speedfactories in Ansbach and Atlanta, which I will discuss later. However, I will first shift the focus to 3D printing in the Speedfactories.

4.6 3D printing and the Speedfactories

Originally, 3D printing was not part of the Speedfactory. Adidas explored 3D printing methods since the early 2000s, initially for rapid prototyping and later also for actual

production until the first concept shoe with a 3D printed midsole was revealed in October 2015 together with the additive manufacturing company Materialise using Selective Laser Sintering as the 3D printing method (Slocombe, 2020; Cheng, 2018; Adidas, 2015b; Cocking, 2015; Materialise, n.d.). In 2016, the concept shoes with 3D printed midsoles were gifted to winners of the Olympics in Rio and commercialized in December 2016 under the name Futurecraft 3D, as 300 pairs were sold for $333.

Only in 2017, 3D printing and the Speedfactory converged. On April 7, 2017, Adidas officially announced an exclusive partnership with the Silicon Valley-based 3D printing start-up Carbon (Adidas, 2017e). Founded in 2013, Adidas first noticed Carbon in late 2015 and decided to invest into the start-up, later valued at over $1.7 billion, next to other investors including Google and BMW (Krassenstein, 2015; Slocombe, 2020; Cheng, 2018; Schering, 2017). The partnership was later further strengthened as Adidas board member Eric Liedtke also joined Carbon's board of directors (Carbon, 2018; Chang, 2018). With the disclosing of the partnership, Adidas announced the implementation of Carbon's 3D printing technology into the Speedfactory to produce the concept shoe Futurecraft 4D, for which – similarly to the to the Futurecraft 3D – only the midsole is 3D printed. The name Futurecraft 4D refers to the shoe as the next generation compared to the previous 3D printed model while simultaneously 4D includes the consumer as the fourth dimension. First pairs were produced for family and friends in April 2017, while the commercial launch with 5,000 pairs was announced for the following winter (Adidas, 2017e; Scott, 2017; Slocombe, 2020). All following models with 3D printed midsoles are referred to as 4D models.

Carbon's 3D printing methods are very distinct from others. The process pioneered by Carbon called Digital Light Synthesis (DLS) is based on a set-up referred to as Continuous Liquid Interface Production (CLIP). All traditional methods, such as Selective

Laser Sintering, print the desired object layer-by-layer. In contrast, Carbon's process produces a continuous output. Essentially, UV light is projected through an oxygen-permeable window at the bottom of a tank containing UV-curable liquid resins, a mix of photo polymers and polyurethane called EPU 40, out of which the desired shape solidifies and can be retrieved. Hence, the printed goods are commonly referred to as printed by "light and oxygen" (Carbon, n.d. a, n.d. c; Schering, 2017). After the printing, support structures are removed from the midsoles, which are then cured in an oven (Peels, 2019; Slocombe, 2020). Compared to standard 3D printers, Carbon's M-series printers have several advantages due to the use of DLS. Most significantly, the printing process is accelerated by a factor of 25 to 100, enabling printing a midsole within 90 minutes initially, which was later reduced to 20 minutes (Scott, 2017, Krassenstein, 2015; All3DP, 2020). Additionally, the midsoles feature a new lattice structure developed by Carbon, which can be given different functional properties, e.g., cushioning and stability, across different zones based on runners' data, while eventually the properties might also be customizable to individual athletes (Adidas, 2017e, 2019a; Slocombe, 2020). Moreover, Carbon's technology also enabled Adidas to overcome further limitations of traditional 3D printing including certain design restrictions and typically insufficient surface qualities (Adidas, 2017e; Smith, 2019; Schering, 2017; Carbon, 2017a). Lastly, the usability of Carbon's printers for production as well as rapid prototyping also enabled Adidas to accelerate product innovation by creating ten times more product iterations in a shorter time span and thus saving up to five months compared to the traditional process (Slocombe, 2020; Young, 2017). However, some challenges also remained. Not all parts of a shoe are 3D printable, thus the integration into the remaining production processes was required (Interviewee A, personal communication, 10 Dec 2020). Additionally, the production costs were high. An estimate by

Peels (2017) puts the costs per midsole in the early production at $44.20, which would explain the initial retail prices of over $300 of 4D shoes (Chang, 2018).

While adidas publicly announced the introduction of Carbon's printers into the factory, which I confirmed did happen (Interviewee A, personal communication, 10 Dec 2020; Oechsler, n.d. f), no other Adidas sources, except for the final announcement of the closing of the factories, link 3D printing to the Speedfactory. This is especially surprising as the AM4 models were actively promoted under the Speedfactory umbrella (e.g., Adidas, 2018e, 2018f). The reason is that Adidas regarded the Speedfactory and 3D printing as two separate things. Due to the fit of 3D printing into the narrative, it was implemented into the Speedfactories. However, 3D printing never became part of the previously depicted original Speedfactory process. While 3D printers were in the Speedfactory, the processes of the 4D shoe production were completely separate from AM4 production. The midsoles of 4D models were 3D printed in the Speedfactory but all other shoe parts were produced using the traditional processes and not the Speedfactory processes. As a result, the 4D models feature the 3D printed midsole with its signature lattice structure while the uppers are identical to non-Speedfactory models (Interviewee A, personal communication, 10 Dec 2020; Oechsler, 2020). Thus, the compromise between traditional and new manufacturing, that was enforced upon the Speedfactory during its course, was already present for 4D production from its outset.

Due to the effectiveness of Carbon's technology and the use of traditional production for the largest part of the shoes, Adidas realized that 4D models could be scaled faster than the AM4 series (Interviewee A, personal communication, 2020; Adidas, 2018a; Cheng, 2018). After launching the Futurecraft 4D for $300 on January 18, 2018, which sold out instantly (Chang, 2018; Adidas, 2019b), Adidas quickly expanded its range of 4D products. In 2018 alone, Adidas already produced 100,000 4D pairs, which was

further scaled in the next year (Adidas, 2020b) while the capacity of the 3D printers was already estimated to exceed one million pairs annually in 2018 (Cheng, 2018). Up to now, 4D has become a mainstay in Adidas running shoe portfolio (Adidas, 2019c) with over 25 different models having been released with many more variations in colors. A list of 4D models is presented in Table 2 in the appendix. While this seems less than for the AM4 series, note that essentially the raw model was near identical throughout the AM4 models whereas the 4D series features actually different models (see images in Figure 8 in the appendix). Similar to AM4, the 4D models were well received. Despite high prices, customer demand was high while reselling prices often exceed retail values (Cheng, 2018; Carbon, 2020b). However, the 4D models are not considered superior to Adidas' other running shoes despite the innovative 3D printing process as they are perceived as heavier and more inflexible (Woolf, 2018).

4.7 Termination and relocation to Asia

As foreshadowed, the developments around the Speedfactories ultimately culminated in Adidas announcing the closing of both facilities by April 2020 on November 11, 2019 (Adidas, 2019d). According to Adidas, the costs of the shutdowns were already fully included in the financial years 2018 and 2019 whereas 2020 would be unaffected (Bain, 2019), indicating that the transfer has been planned in advance, consistent with the previously reported shifts in the strategy. Simultaneously, Adidas announced the transfer of technologies used in the Speedfactory to two of their suppliers in China and Vietnam. In their official statement, Adidas argued that joining the technologies with the capabilities and technological advances of the suppliers will result in a more flexible and economic use. Additionally, the transfer should enable the production of more product types via Speedfactory technologies (Adidas, 2019d).

Lastly, Adidas did not just simply transfer all Speedfactory technologies to Asia as a closed construct. The Speedfactory project was broken into parts as only some processes were transferred to Asia and integrated into existing processes (Interviewee A, personal communication, 10 Dec 2020). The transfer to Asia also applies to the 3D printers from the Speedfactories, which even became an increased area of focus afterwards (Carbon, 2019b; Peels, 2019; Interviewee A, personal communication, 10 Dec 2020). The partnership with Oechsler will continue in 3D printing as well as the partnership with Carbon (Davies, 2019). As a result, Adidas still continuously produces 4D shoe models (see Table 2 in the appendix), including long-term projects such as Futurecraft Strung (Adidas, 2020d). Currently, ten different 4D models, in various designs each, are available from Adidas online store (Adidas, 2021).

5 Case analysis

In the following two chapters, I will analyze the case of the Adidas Speedfactories to derive insights on location decisions with innovative production facilities. I explicitly focus on the case in this chapter by discussing the drivers of the location decisions by Adidas before then generalizing findings in the next chapter.

First, I want to underline the presence of location decisions in the case. The original offshoring of production to Asia in the last century, the reshoring by setting up the first Speedfactory in Germany and the opening of the Atlanta facility unambiguously are location decisions. While the move to Atlanta is no actual reshoring, I argue that it can be jointly discussed with the reshoring to Ansbach as the US facility constitutes a clear continuation of the reshoring strategy of the first Speedfactory. The transfer of the Speedfactory to Asia represents the final location decision in this case. While one might object that only some of the employed technologies were transferred to existing factories, I argue the simultaneous occurrence of the factory closure and the

technology transfer result in a shift of production capacities from Germany (and the US) to Asia which can be equated with offshoring. Additionally, Interviewee A (personal communication, 10 Dec 2020) emphasizes that the Speedfactory concept is still present in Asia, albeit in a modified form, while the output of 4D models even increased after the transfer (Sneaker Freaker, 2020), leading to the conclusion that the technology transfer effectively meant the relocation of the Speedfactory. Thus, the case developments can be summarized as follows: Adidas originally offshored production in the past century, reshored production with the Speedfactories and finally offshored them again. Both the reshoring and the final offshoring to Asia are location decisions with innovative production facilities in the meaning of the research questions and are thus my analytical focus.

I will also follow up on the notion that reshoring decisions need to be discussed against the background of the previous offshoring of production (Kinkel and Maloca, 2009; Tate and Bals, 2016). I extend this concept to the final offshoring of the Speedfactories as well because it also resembles a reversal or over-writing of the earlier reshoring. Hence, I will also explore each location decisions in contrast to the respectively previous decision.

5.1 Drivers of reshoring via the Speedfactories

The collected case materials report a variety of motivations for the set-up of the Speedfactories. However, two restrictions on the relevance of the reported drivers have to be considered. First, most case sources do not distinguish between motives to create the Speedfactory and motives to set it up in Germany, i.e., to reshore production. For the purpose of this study, the difference between the two is highly relevant. As the aim is to explore location decisions in the presence of innovative production facilities, these facilities are a prerequisite for the researched issue and the preceding reasons to

establish them are not of primary interest. Consequently, drivers to create the Speedfactory including the aim to reduce manual work via automation will not be discussed here. Rather, I will discern and explore drivers that can explain why the Speedfactory was specifically established in the chosen location. The second restriction regards 3D printing. As shown, 3D printing was only included in the project well after reshoring while no evidence of a previous connection or intent at the time of the development of the Speedfactory to later include 3D printing exists. Therefore, 3D printing cannot have affected the reshoring decision and will not be considered here.

5.1.1 Drivers

The initial idea of the Speedfactory was to increase speed (Interviewee A, personal communication, 10 Dec 2020, Manthorpe, 2017). While speed also results from the process automation itself, the primary source of speed is the proximity to the target market (Interviewee A, personal communication, 10 Dec 2020). As this proximity is a direct function of the production location, speed was the primary motive to choose Germany and the US as production locations given the importance of these two markets (Bain, 2019; also recall Figure 4). Via market proximity, Adidas aimed at the reduction lead times by cutting shipping times (Interviewee A, personal communication; Reuters, 2016; The Future Factory, 2018; Adidas, 2016b; Manz, 2016). By decreasing lead times, Adidas hoped to also increase its responsiveness to incorporate user insights and respond to local trends quickly (Adidas, 2015c; Manz, 2016; Manthorpe, 2017; Henkel, 2016) as well as to enable on-demand production (Adidas, 2017c; The Future Factory, 2018). Here, Adidas is likely to have been driven by new demand patterns, as fast fashion and modern standards of rapid delivery à la Amazon Prime result in the consumer expectation of fast access to goods (Bain, n.d.; Wiener, 2017). On-demand production was also specifically desired by Adidas to reduce

inventory and to prevent losses caused by end-of-season markdowns of leftover stock (Manz, 2016; Adidas, 2017c).

Further, Adidas based the reshoring decision on multiple minor supporting drivers, which I will therefore present less elaborately. A goal of the Speedfactory was accelerating product innovation. While this goal was primarily to be reached via the new technologies, literature commonly points at the effect of co-locating R&D and production on accelerating innovation (e.g., De Backer et al., 2016; Pisano and Shih, 2009; Whitfield, 2017). This might suggest that the goal of accelerating product development cycles also induced Adidas to set up the Speedfactory onshore in proximity to R&D. But due to the lack of a supporting public statement by Adidas, this can only be regarded as a minor potential driver. Similarly to product innovation but potentially more importantly, the intent of driving process improvements within the Speedfactory may have been a reason to opt for R&D proximity. Note that the Speedfactory processes were in a constant pilot mode throughout the course of the project, i.e., they were continuously developed and refined (Interviewee A, personal communication, 10 Dec 2020). Thus, co-locating R&D and the Speedfactory might have been a factor in Adidas' location decision to accelerate the advancement of the processes.

Moreover, Interviewee A (personal communication, 10 Dec 2020) states that a goal of the onshore location within the respective target market was increased flexibility by producing only comparably small volumes for local markets. By decreasing the batch size through reshoring, Adidas wanted to thus lower their costs and the risks attached to large production volumes, i.e., disruption risks and demand uncertainty.

An additional reshoring motive may be leverage over suppliers. Interviewee A (personal communication, 10 Dec 2020) indicates that Adidas used the Speedfactory to

pressure their Asian suppliers to lower their prices already in the early phases of the Speedfactory, which suggests that it might have been planned from the beginning. The ability to use the Speedfactory as leverage is not directly related to its location but rather depends on the signaled independence from existing suppliers, which feared losing Adidas as a customer and thus reduced their prices. However, I argue that choosing a totally different location, geographically and in terms of country-specific factors, sends a clear signal to suppliers that the firm can produce without their low-cost production. Hence, this motive might have supported the choice of an onshore location for the Speedfactory.

Next, Adidas announced that the Speedfactory would also boost the firm's sustainability efforts by reducing shipping and the use of adhesives (Adidas, 2015c; Manz, 2016). The latter however stems from the new processes and not the location and while reduced shipping is a result of the reshoring, the environmental benefits appear more as a byproduct from market proximity following Adidas' speed imperative as explained above. Therefore, whereas reshoring positively affects sustainability, it can only be regarded as a minor driver to reshore production in this case.

Given the complex production network in Asia, one of the goals of reshoring production was the reduction of supply chain complexity by concentrating production in independent local hubs (Adidas, 2017c; Manz, 2016). Although I already alluded to the concept of localized production in the context of speed, here the focus lies on the associated reduction of planning effort and coordination costs as essentially all processes are concentrated within one factory in the target market. Therefore, the goal to reduce supply chain complexity was a driver of localizing production, while the added control over operations close to the corporate headquarters (Manz, 2016) further supported the reshoring decision.

A further factor may be the location of key partners. Due to the outsource production, Adidas did no longer possess any manufacturing capabilities. While I have previously shown that this can be a barrier, Adidas circumvented this issue by outsourcing the reshored production to Oechsler (Interviewee A, personal communication, 10 Dec 2020). With Adidas having decided on Oechsler as the partner of choice in 2014 (Adidas, 2017c), the later decision on Ansbach as the location of the Speedfactory is not surprising given that Oechsler's headquarters too are located in Ansbach near the Speedfactory (Oechsler, n.d. b). Thus, the location of a key partner evidently impacted Adidas' reshoring decision.

Additionally, the made-in effect as reported by Grappi et al. (2015) may have supported the reshoring decision. Adidas intended to actively market Speedfactory products with an explicit reference to their origin (Interviewee A, personal communication, 10 Dec 2020). Thus, Adidas wanted to utilize the onshore location specifically to evoke positive consumer reactions, which might have been considered during in the reshoring decision already.

Further, automation influenced the reshoring decisions. Adidas has reportedly still been highly dependent on low labor costs in Asia in recent years (Interviewee A, personal communication, 10 Dec 2020). By increasing automation, Adidas aimed to mitigate the need of low labor costs so that the Speedfactory could be set up anywhere irrespective of wage levels (Interviewee A, personal communication, 10 Dec 2020). While automation therefore has not directly induced reshoring, it enabled Adidas to select the location based on other factors, i.e., the aforementioned drivers, and thus indirectly affected the reshoring decision.

Finally, Adidas' vision regarding the Speedfactories affected the reshoring decision. In the initial plans, the facilities in Ansbach and Atlanta were just the first step. Multiple publications by Adidas and statements by key representatives identify a global network of Speedfactories, eventually replacing traditional production in Asia, as the originally ultimate goal of the Speedfactory (e.g., Manz, 2016; Adidas, 2017a; Reuters, 2016). With these plans to subsequently establish facilities around the globe, the reshoring as the first step appears intuitively logical.

5.1.2 Synthesis

Based on this analysis, it becomes clear that a multidimensional decision-making process was involved. Although the main goal of the Speedfactory and the specific locations evidently was increased speed, a plethora of other factors supported the location decision as shown in Figure 5.

Based on this figure, I want to further highlight select results. Several drivers, including *demand proximity*, *lead time impact* (i.e., speed), *responsiveness*, *co-location with R&D*, the *made-in effect* and *sustainability* clearly fit the respective description presented in the theoretical part of this study but other connections of the Adidas-specific drivers to the framework need clarification. *Automation* and the linked *productivity gains* serve as an enabler of the reshoring. The reduction of supply chain complexity via reshoring relates to the reduction of *coordination* and *communication costs* in the figure. *Changing demand patterns* here refer to the trends of fast fashion and rapid delivery that affected Adidas' decision. *Flexibility* relates to small volume production in the case of Adidas and was aimed at the reduction *global supply chain risks* associated with traditional production. On-demand production was to reduce *inventory* and *end-of-season markdowns*. *Access to knowledge* here takes the form of Adidas selecting a location close to their partner Oechsler. Thus, Figure 5 shows that Adidas'

Figure 5 – Drivers of Adidas' reshoring decision

This figure is based on Figure 2. Drivers applicable to Adidas' reshoring decision are highlighted among the reshoring drivers from literature. Novel drivers are italicized.

	Internal Environment		**External Environment**	
Customer Perceived Value		Sustainability Lead time impact		
	Automation/Industry 4.0 Restructuring towards lean Low trust in foreign operations Demand proximity Mitigate supplier dependence Termination of supply relations Bandwagon effect Need for turnaround Correction of misguided decision Mitigate unintended strategic costs of offshoring (hollowed out, skill gaps, innovation lags) Change of business strategy *First step of transformation to decentral production network with globally distributed local hubs*	Home bias Patriotism/Loyalty/Sense of belonging Innovative products Responsiveness Flexibility Innovation and R&D proximity Refocus on core activities	Availability of resources Availability of labor Working attitude in host country Poor manufacturing quality Positive image effects of reshoring Domestic goodwill Made-in Effect / Willingness to pay/buy Changing demand patterns (e.g. customization) Shortened lifecycles IP risks Access to knowledge Enable process knowledge transfer Access to technology	Resource competition in host country Global SC risks (e.g. shortages, disruption) Political risks Trade policies Government incentives & policies Global/local economic changes/downturns (need to reevaluate
Cost Efficiency		High inventory (in-transit & safety stock) Losses due to markdowns Penalties for late orders Coordination costs Communication costs Bureaucracy & administrative costs	Tariffs Productivity gains Labor turnover in host country Energy costs Eroding labor cost advantages Currency/Exchange rate risk Lack of infrastructure in the host country Cultural distance *Create leverage over offshore suppliers*	
		Transport costs Idle capacity at home Union's pressure in home country		

reshoring decision was largely in line with known reshoring drivers. In addition, two novel drivers are revealed, which I added to the framework. Based on the literature presented in chapter 2, the use of partial reshoring of production to *create leverage over offshore suppliers* has not been previously discussed as a reshoring motive.

Similarly, reshoring as an *antecedent of a decentral production network with local hubs* appears to be a motivation unique to the Speedfactory case.

Finally, a *change of business strategy* serves as the overarching explanation of the reshoring decision in comparison to the previous offshoring. Recall that in literature three rival explanations exist for reshoring: changes of exogenous factors, changes in managerial valuation and corrections of misguided offshoring decisions. Prima facie evidence suggests that Adidas offshored production to Asia in the 1980s to reduce production costs especially by accessing low-cost labor (European Reshoring Monitor, n.d.; Manthorpe, 2017). In contrast, Adidas clearly set a new strategic focus on innovation and speed with the reshoring and weighed costs less in the decision. Hence, the case lends support to the change-in-managerial-valuation explanation as well as the change-of-exogenous-factors explanation, since the change of strategy was partly induced by external factors such as the emergence of I4.0 technology and changing customer expectations. On the contrary, the correction-of-a-misguided-decision hypothesis has to be rejected here, especially since Adidas did not reverse its offshoring decision but only supplemented it with the Speedfactory.

Following the case study methodology, I will next discuss further drivers from the framework, i.e., potential rival explanations (Yin, 2018, pp. 224-228), for which I found no supporting evidence. First, the eroding cost advantages of offshore locations, commonly pronounced in research, have seemingly not affected Adidas' reshoring decision. A potential reason for this is that labor costs are less relevant due to automation. Additionally, Adidas exhibited the strategy of relocating to other lower-cost countries, especially Vietnam as depicted in Figure 3 earlier, as wages increased in China. Thus, cost increases are already mitigated and are no driver of reshoring for Adidas. Second, quality issues associated with offshore production have been discussed as a frequent

driver in chapter 2. Although Adidas reports a more consistent quality as a target of the Speedfactory production (Manz, 2016), this goal is clearly enabled by the employed technologies and not the location. Hence, I4.0 technologies actually moderate this theoretical reshoring driver by enabling a high production quality irrespective of chosen location. Third, intellectual property risks are surprisingly not a driver for Adidas. Intuitively, one could expect that due to the involvement of advanced technologies Adidas would prefer locations offering higher intellectual property protection. However, evidence shows that Adidas was confident in its ability to create binding agreements with its partners to protect intellectual protection independently from the chosen location (Interviewee A, personal communication, 10 Dec 2020). Finally, I find no conclusive support for cognitive biases. While I cannot rule out bandwagon effects as other reshoring cases might have indirectly influenced Adidas, the abundance of detected drivers indicates that Adidas' reshoring decision was based on logical evaluations rather than on decision biases.

5.2 Drivers of offshoring the Speedfactories to Asia

Compared to the reshoring, analyzing the drivers of the offshoring of the Speedfactories to Asia is distinctively harder. Whereas Adidas openly communicated its goals in reshoring the Speedfactory across a variety of sources, they only made select public statements on the reasons for transferring the project to Asia in the press release on the closing of the Speedfactories (Adidas, 2019d). Therefore, more effort is required to discern all relevant drivers as I have to resort to circumstantial evidence to complement Adidas' limited public statements. The remainder of this subsection follows the same structure as the previous subsection, I will outline and discuss all potential drivers identified from the variety of case materials and then synthesize the results.

5.2.1 Drivers

First, failures of the processes could have caused the offshoring. The major failure of the Speedfactory processes is their inability to produce multiple types of products as processes were tailored to specific properties and materials of the chosen running shoe type (Interviewee A, personal communication, 10 Dec 2020; Bain, 2019). Consequently, the range of products and thus the scalability of the Speedfactory concept was limited. Bain (n.d.) further suggests that this issue especially constrained the Speedfactories due to the inability to produce top sellers such as the lifestyle shoes "Stan Smith" and "Superstar". Adidas' final press release supports this argumentation as it stated that the relocation to Asia aims at enabling the production of multiple different product types (Adidas, 2019d). In addition, Speedfactory-operator Oechsler notes in their annual report that the offshoring occurred as the production in Asia was found to be superior compared to the Speedfactory processes (Oechsler, 2020). Thus, process failures seem to have played a role in driving Adidas to offshore the Speedfactories.

Earlier, I noted that changes of wage levels did not appear relevant for Adidas' reshoring decision. On the contrary, I argue that rising labor costs offshore affected the offshoring to Asia. Weiss (2017) mentions Adidas' plans to implement Speedfactory technologies at Asian supplier factories to counter rising wages in Asia via automation. Interestingly, this resembles a complete reversal of the classic argumentation of rising wages at offshore locations driving reshoring as here rising wages potentially incentivized Adidas to offshore innovative production techniques to Asia in order to directly remedy the higher labor costs at the source.

For the reshoring, I found that Adidas sought access to knowledge of key partners. However, Adidas' statements on the transfer to Asia indicate that this knowledge may have been insufficient. Specifically, Adidas mentioned that the transfer occurred to

use the capabilities of the Asian suppliers to enhance the potential of the Speedfactory by overcoming the previously explored process failures (Adidas, 2019d; Ziady, 2019; Bain, 2019). Based on Adidas' statements, the access to supplier knowledge is the most pronounced driver of the offshoring although it remains undisclosed which specific capabilities the suppliers offer that could advance the Speedfactory processes. Also, note that the argument of accessing supplier knowledge is seemingly paradox given the aforementioned motivation to give the technology to Asia for boosting automation. Both explanations combinedly would mean that Adidas offshored the technologies to Asia to overcome technological shortcomings there while simultaneously hoping that the suppliers could overcome the challenges of the Speedfactory technology. Regardless, the increased availability and success of Adidas 4D products after the relocation to Asia (JustFreshKicks, 2020d) suggest that the suppliers were indeed able to further improve the Speedfactory concept at least by providing mass production capabilities.

The shift to an increased focus on Adidas' 4D models may have also directly impacted the offshoring decision. In the press release concerning the relocation, Adidas explicitly named its 4D product line as the new area of focus (Adidas, 2019d), while Marco Kormann, Director of Technology Innovation at Adidas, elaborated on the goal to enable mass production of 4D products (Slocombe, 2020). Furthermore, Interviewee A (personal communication, 10 Dec 2020) stated that 3D printing was specifically prioritized over the original Speedfactory technologies. To understand why this prioritization potentially favors the relocation to Asia over the Speedfactories' original locations, the notion of 4D products as a compromise between the traditional and the new manufacturing worlds has to be recapitulated. The midsole is produced using Carbon's 3D printing technology while the remaining shoe parts are produced using the

traditional processes (Interviewee A, personal communication, 10 Dec 2020). These processes have effectively been optimized in Asia over decades ever since Adidas first outsourced production. Now with the goal of further scaling the production volumes of 4D products (Adidas, 2020b; Carbon, 2019b) and since 4D production already resembled a compromise before, it seems very reasonable to physically join the relatively new 3D printers with these optimized and well-established processes in Asia. This strategy to offshore the Speedfactories to enable the scaling of 4D production is further underpinned by the thereby increased output and success of 4D products in 2020 (Sneaker Freaker, 2020; JustFreshKicks, 2020d). This line of argumentation also potentially remedies the earlier paradox of giving the technology to the suppliers to boost automation while simultaneously using their capabilities to enhance the technologies. While the original Speedfactory technologies may enhance the traditional production process in Asia, the suppliers enable mass production of 4D products.

Another major driver of the offshoring may be the shift of the strategic focus. Interviewee A (personal communication, 10 Dec 2020) unambiguously indicates the transition to a new CEO in the end of 2016 as the key trigger of this shift as the new CEO Kasper Rorsted appeared to be distinctively more focused on cost than his predecessor. This notion is further supported by the CEO's skeptic statements regarding the Speedfactories in contrast to his predecessor (Hancock, 2017). Mid-project, Adidas therefore began to increasingly apply cost and profitability KPIs to the Speedfactory whereas the project team was previously freer to drive innovation relatively irrespective of costs (Interviewee A, personal communication, 10 Dec 2020). The conclusion suggests itself that the offshoring to Asia was a result from this cost focus and aimed specifically to reduce costs by operating the Speedfactories more economically in Asia. This notion of economically operating the Speedfactories also appears in Adidas'

press release concerning the transfer (Adidas, 2019d), further stressing costs as a key driver. Against this background, Adidas' public statements that the reasons were not so much financial but rather organizational (Ziady, 2019; Pankow, 2019) may be interpreted as an attempt to portray the transfer more positively, while also hinting at the relevance of other aforementioned drivers.

To further investigate costs as a driver, an analysis of the costs connected to the Speedfactory is required. The as of yet immature advanced technologies resulted in comparably high unit production costs (Peels, 2017) while the duplication of capital assets associated with the independent Speedfactories further drove up costs (Smith, 2019). In addition, the developed processes might have been used uneconomically. An adidas spokesperson states that the facility in Ansbach has not been working at full capacity until its closure (Pankow, 2019) while economies of scale have already been significantly lower than in Asia regardless (Smith, 2019). Hence, CEO Kasper Rorsted already hinted at a transfer to Asia in an interview in 2017 as using advanced and expensive processes for a small market segment via the AM4 series was not paying off (Hancock, 2017). Based on these arguments, the top-down introduction of a new cost-based strategy concerning the Speedfactory emerges as a key driver of the offshoring to Asia.

Finally, the role of speed has to be discussed as it has been the key motivation for the previous reshoring. But eventually, Adidas realized that their competitors are just as slow as Adidas via their traditional production (Interviewee A, personal communication, 10 Dec 2020). Therefore, while Adidas could gain a competitive advantage by increasing speed, no relative disadvantage would result from falling back on the status quo. With the previously explored factors presenting themselves to Adidas as new priorities, it appears the new evaluation yielded that speed from the onshore location

was no longer an imperative in the short run. Concurrently, Adidas realized that even by locating the Speedfactories in Asia, the advanced processes still result in shorter lead times than traditionally (Adidas, 2019d), albeit probably significantly longer than with the onshore locations as demand proximity was the key source of speed (Interviewee A, personal communication, 10 Dec 2020). Thus, the relocation to Asia resembles a new compromise between the other aforementioned drivers and speed. Additionally, Adidas recognized that they could still focus on delivering products on time via different measures, such as big data analytics to understand consumer preferences earlier, which are more compatible with the new cost focus and Speedfactory production in Asia (Interviewee A, personal communication, 10 Dec 2020).

5.2.2 Synthesis

Following the same procedure as in the reshoring analysis, I highlighted the drivers applicable to Adidas in Figure 6.

From this figure, it becomes clear that Adidas' decision to offshore the Speedfactories to Asia is based on several of the key drivers reported in literature. The traditionally most pronounced motive to reduce *production costs* (e.g., Kinkel and Maloca, 2009; Kazmer, 2014; Kakabadse and Kakabadse, 2000) applies to Adidas following their *change of strategy* which is therefore included as an additional driver. Closely related to production costs, Adidas intent to enable *mass production* of 4D products and yield *economies of scale*. In this process, Adidas wanted to *leverage the capabilities of their Asian suppliers* and *access their knowledge* to enable economic large-scale production and overcome the *process failures* of the Speedfactory. *Automation* and *rising labor costs* in the offshore nations, both typically seen as reshoring drivers, actually supported the offshoring decision here as Adidas intended to compensate increasing

Figure 6 – Drivers of Adidas' offshoring decision

This figure is based on Figure 1. Drivers applicable to Adidas' offshoring decision are highlighted among the offshoring drivers from literature. Novel offshoring drivers are italicized.

<table>
<tr><th></th><th>Internal Environment</th><th colspan="2">External Environment</th></tr>
<tr><td rowspan="3">Customer Perceived Value</td><td></td><td colspan="2">Access to new markets</td></tr>
<tr><td rowspan="2">Demand proximity
Perceived need to not miss opportunity
Bandwagon
Strengthen offshore relationships
Dampen competition
Change of business strategy
Automation/I4.0 technologies
Enable mass production of specific products</td><td>Allows focus on core capabilities
Process Failures</td><td>Quality improvements
Lack of skilled labor in home country/Availability in host country
Lack of resources in home country/Availability in host country
Countertrade requirements
Foreign market access or development</td><td rowspan="2">Decreased trade barriers
Factor-market rivalry
Business-friendly regulations
Access to networks/innovation clusters/strategic alliances
Leverage capabilities of foreign suppliers
Foreign goodwill
Access to local knowledge & learning
Access to technology</td></tr>
<tr><td>Cost Efficiency</td><td>Reduction of communication costs
Economies of scale
Standardized and low skill processes</td><td>Search for pollution havens to avoid environmental regulations
Tax benefits
Converging consumer tastes
Productivity
Labor costs
Production costs
Rising labor costs in Asia</td></tr>
<tr><td></td><td></td><td colspan="2">Reduction of transport costs
Transfer demand uncertainty to suppliers
Local capacity constraints in home country
Synergies of resources/skills</td><td></td></tr>
</table>

wages with increased automation directly at the source. Hence, both factors are included in the figure. Lastly, note that the reevaluation of speed is not a driver per se and is thus not included in the framework. Combinedly with the shift to a cost focus, this illustrates that the offshoring decision too resulted from a change in managerial valuation compared to the previous reshoring whereas little to no evidence supports the change-of-exogenous-factors and correction-of-a-misguided-decision hypotheses in this case.

Similar to the reshoring analysis, I will also briefly discuss rival hypotheses. An obvious explanation for the offshoring would be that the reshoring decision was revoked as Speedfactories failed to reach their goals. However, the initial goals of the Speedfactory of enhancing speed and responsiveness, reducing of manual labor, increasing product customization and sustainability were largely achieved. Lead times were decreased and innovation cycles accelerated while reducing manual labor and producing more sustainably. Only customization never reached the envisioned personalized level, but this hardly decided the Speedfactories' fate on its own. Nonetheless, the reason for the offshoring may have also been the failure of the roll out plan rather than of the initial goals. While the first two phases largely adhered to Adidas' plan, the firm intentionally diverged from the planned third phase. By the start of the third project phase set for 2019, Adidas' strategy for the Speedfactory had already shifted to the cost focus and they began planning for a potential transfer to Asia as stated before. Thus, evidence suggests that Adidas did not reach their goals according to the roll out plan because they overhauled their plan and not vice versa.

Further, Adidas may have revoked the reshoring due to the failure of the products from the Speedfactory. First, the product range, especially the AM4 series, consisted primarily of limited editions with low total sales volumes per model (Weiss, 2017; JustFreshKicks, 2019h). Hence, one could argue that the products were no fit for the mass market. Second, the products were not innovative despite the use of advanced manufacturing processes and greatly resembled Adidas' products from Asia (Bain, n.d.; Wiener, 2017; Manthorpe, 2017). Finally, the production capacity of the Speedfactories was low compared to Adidas' total footwear production with less than one out of 400 pairs being produced there (Ziady, 2019), albeit this capacity limit was in accordance with the roll out plan. Contrary to these arguments, there clearly was strong

demand for the products with releases selling out immediately (e.g., Wiener, 2017; Adidas, 2019b) and high reselling values on auction sites (e.g., StockX, 2021n). In addition, the continuation of the 4D series beyond the offshoring shows that product failures were not a relevant driver of the offshoring decision.

Moreover, Belotto (2020) proposes a variety of hypotheses. First, the author describes the lack of labor availability onshore as a potential factor. However, given the working operations and continuous product output from the Speedfactory, it appears that scarce labor availability has been overcome. Second, Belotto argues that the offshoring occurred to produce in proximity to the strongly growing Asian market. This explanation suffers from an obvious flaw as the search for market proximity stands in a stark contrast to the abandoning of Speedfactory production in the other key markets. The last suggested explanation by Belotto depicts the Speedfactory project as a test run with the pre-determined plan to relocate to Asia once the processes have been sufficiently developed. Although such plans emerged during the course of the project, the publicized vision of a global Speedfactory network shows an initially different plan.

To conclude the case analysis, the developments can be summarized as follows. The Speedfactory originally targeted the key goal of drastically increasing speed via customer proximity from reshoring supported by the use of advanced technologies and process innovations. In the following, the shift to cost as the new strategic focus induced by management changes resulted in compromises regarding the use of new and traditional processes in the Speedfactory. The later offshoring seems to be the inevitable consequence of these compromises and the cost focus as it resembled the most efficient way to fully join the new and old processes. Simultaneously, Adidas chose to focus on scaling the 4D production, partly because of limitations of the original Speedfactory processes. Thus, Adidas made the decision to prioritize the efficient scaling of

the technologies short-term via the suppliers' mass production capabilities, resulting in the offshoring of the Speedfactories to Asia. Thereby, Adidas abandoned the original long-term vision of localized production in a distributed network of Speedfactories. Further, I argue that the focus on costs and on 4D production can only jointly explain the offshoring. With only the 4D focus, the closing of the onshore Speedfactories could not be sufficiently explained as their continuation might have still complemented production in Asia. In contrast, the cost focus on its own does not provide sufficient insights on why the Speedfactory concept was transferred and not simply discontinued.

6 Discussion

Based on the results from the preceding chapter, I will now aim to derive generalizable insights. Due to the employed single case study method, I will not try to extrapolate results but instead argue which concepts revealed by this study may also be relevant in other cases. Therefore, the goal in this chapter is to develop propositions which offer guidance in this new subcategory of location decisions. In a second step, I will then discuss limitations of these findings.

6.1 Results

At the outset, I defined the aim of this case study as the derivation of insights regarding location decisions with innovative production facilities. Specifically, the implications of employing such facilities on location, the drivers of these decisions and the moderating effect of the facilities on other drivers are of main interest. In the following, I group my findings into four sets of propositions.

6.1.1 Location decisions with innovative production facilities

In the presented case, the innovative production facilities – the Speedfactories – are clearly distinguished from the remaining offshore production by use of I4.0 technologies, different labor requirements, i.e., less workers but also different required skills

related to the new machines, and a production concept concentrating all processes in one factory. Consequently, the Speedfactory diverges from the remaining production by enabling higher production speed, lower labor costs due to automation and initially higher unit production costs. Although the specific design of processes within innovative production facilities and their implications may be unique to the respective purpose, the distinction from a firm's remaining production will also hold true for other cases. Per definition, innovative production facilities feature advanced processes or technologies that are unique within a firm's production network. These differences in turn lead to differences in required inputs, such as different labor skills or raw materials, and performance, including speed, productivity and labor costs as in the case of the Speedfactory. Therefore, location factors, such as labor costs, which affect location decisions may be weighed differently for decisions involving innovative production facilities. Consequently, firms have to make these location decisions independently from previous location decisions in absence of such facilities.

Simultaneously, I argue that for similar reasons the plan to establish innovative production facilities is likely to overcome a firm's inertia to relocate. Generally, organizations are found to resist change without external pressure (Hannan and Freeman, 1984), which also implies the reluctance to relocate production as supported by Manning (2014). Following this theory, a firm planning to establish an innovative production facility could be expected to set it up in the same location as the current production to avoid major changes. However, the Speedfactory case shows that this does not need to be true as Adidas initially chose to reshore production with the Speedfactory without significant exogeneous pressure. This leads me to believe that the outlined distinctions from the remaining production are so significant to the firm that they can overcome the inertia to relocate, lending further support for my first proposition:

Proposition 1a: Innovative production facilities feature unique characteristics which distinguish them from the remaining production and hence mandate independent location decisions tailored to these facilities.

Moreover, the presented case provides insights on the characteristics of location decisions with innovative production facilities. In the theoretical chapter, I showed that location decisions are generally multidimensional with a wide variety of different drivers that can affect the decision. In the preceding chapter, we have seen that this multidimensionality clearly also applies to the Speedfactory with various factors playing a role in the reshoring as well as the offshoring decision. Thereby, it should become clear that while innovative production facilities are relevant, they do not determine location decisions on their own. Specifically, whereas advanced technologies are often discussed as a major reshoring driver (e.g. Tate and Bals, 2016; Nujen et al., 2018; Arancani et al., 2019; De Backer et al., 2018), the case underlines that offshore locations may also be chosen for innovative production facilities.

The case analysis illustrates that, despite the unique features of the Speedfactory, multiple well-explored location drivers still apply. For the reshoring, this includes demand proximity, the aim to increase responsiveness, government incentives and the made-in effect. As these are commonly linked to reshoring in literature even without the involvement of innovative production facilities as discussed in chapter 2, I refer to these drivers as classical. Similarly, Adidas based the offshoring decision of the Speedfactory on classical motives. Particularly, for Adidas' offshoring decision this congruence of drivers with those identified in literature is interesting. With offshoring being a relatively old trend compared to the reshoring phenomenon, one might have expected that firms would have moved on from primarily cost-related offshoring, specifically with innovative production facilities. On the contrary, the case reveals that primary

drivers of the original offshoring waves, being the search for lower labor and production costs and economies of scale, can still be relevant in location decisions with innovative production facilities. Hence, Propositions 1b and 1c are defined as follows:

Proposition 1b: Location decisions with innovative production facilities remain multidimensional.

Proposition 1c: Even with innovative production facilities, classical drivers are still relevant for reshoring and especially offshoring.

6.1.2 Effect of innovative production facilities on location decision drivers

I will next discuss the specific effect of innovative production facilities on location decisions. Previously, I stated that these facilities by themselves do not imply one ideal location without knowledge of other relevant variables. Instead, I argue that they affect location decisions more indirectly by amplifying or moderating other drivers. I explore the exact channels of this effect in the following.

Proposition 2a: Innovative production facilities impact location decisions indirectly by affecting other drivers.

First, the case lends support for an effect that is already known in literature. By increasing automation, less manual labor is needed. Consequently, differences in labor cost levels across locations become less relevant when using I4.0 technologies (Attaran, 2017; Ancarani et al., 2019; Laplume et al., 2016; De Backer et al., 2018). My study highlights this notion as the Speedfactory mitigated Adidas' dependence on low-cost labor offshore and enabled reshoring (Interviewee A, personal communication, 10 Dec 2020). Note that this still does not mean that innovative production facilities generally favor onshore locations. While mitigating a traditionally key advantage of

offshore locations may shift the evaluation towards reshoring, the reduced importance of labor costs only means that other factors become more important. Hence, innovative production facilities enable targeting other strategic priorities via location, as Adidas focused on speed and demand proximity in their reshoring.

Proposition 2b: Innovative production facilities moderate labor costs as a decision driver and thus enable decisions based on other priorities such as demand proximity.

Interestingly, the Speedfactory case reveals a further effect on labor costs. In literature, rising labor costs in the offshore locations are depicted as a driver of reshoring (e.g. De Backer et al., 2016; Ellram et al., 2013; Fratocchi et al., 2014). On the contrary, the case analysis shows that rising wages in Asia might have supported Adidas' decision to relocate the Speedfactories to Asia to directly counter them by increasing automation in supplier factories. Hence, the case exhibits a new way to deal with rising labor costs in offshore locations by mitigating them directly at the source via the offshoring of innovative production facilities. Thus, as an extension of the previous proposition, these facilities can reverse the direction of the classical effect of rising wages:

Proposition 2c: Innovative production facilities can be used to overcome rising wages in offshore locations by countering them with increased automation in these locations and thereby reverse the classical effect of rising wages on location decisions.

The co-location of innovative production facilities and knowledge appears to be highly relevant to the location decision. Here, knowledge takes the form of a firm's internal R&D department. If the firm is hollowed out however, knowledge needs to be outsourced from partners to which proximity then becomes relevant. The importance of access to knowledge is a result from key characteristics of innovative production facilities. At the core of these facilities are innovative technologies and processes. Given

their innovativeness, they can be generally assumed to be less mature and thus require ongoing development and optimization. In line with the RBV, locations for innovative production facilities are therefore expected to be chosen to best enhance the processes long-term. In the case, Adidas' reshoring specifically sought the proximity to their partner Oechsler, who provided the required capabilities to implement and further develop the Speedfactory concept. Similarly, I discussed the access to knowledge of the Asian suppliers as a driver of the later offshoring to overcome the previous shortcomings of the Speedfactory processes and to provide mass production capabilities. This yields the proposition that the proximity to knowledge to further advance the processes, while it is a classical driver, is even more important in location decisions with innovative production facilities.

Proposition 2d: Access to knowledge, depending on the ownership mode resembled by the co-location to R&D or to key partners, becomes a central driver of location decisions with innovative production facilities.

Lastly, the case reveals a connection between innovative production facilities and the made-in effect, which literature sees as a factor supporting reshoring decisions (Grappi et al., 2015). In the case, Adidas marketed the Speedfactory shoe models explicitly by referring to their origin, including the onshore location as well as the innovative production processes. Speedfactory releases such as the Futurecraft M.F.G. or the Futurecraft 4D have witnessed high demand, as indicated by these models selling out instantly, customers camping outside the stores in expectation of the releases and the high reselling values. This high demand cannot be sufficiently explained by only the made-in effect based on the onshore location. Rather, I believe that specifically the conjunction of the onshore location and the employed innovative technologies led to a surge in public attention which caused a hype around the products. Hence, I propose

that innovative production facilities can further enhance the well-known made-in effect, which thus can become a larger factor in a firm's reshoring decision.

Proposition 2e: Innovative production facilities can boost the made-in effect and thereby amplify its influence on reshoring decisions.

6.1.3 Novel reshoring drivers

Further, the case reveals novel reshoring drivers. While these drivers will certainly not affect all location decisions with innovative production facilities, the key finding is that they can be relevant. The first novel driver is the use of reshoring to create leverage over existing offshore suppliers to lower their prices. As described in the case analysis, the primary mechanism here is that reshoring signals independence from supplier production and that these therefore may put effort into maintaining the relationship by lowering their prices. This also underpins that location decisions with innovative production facilities are not isolated but that they can also indirectly affect the remaining production. Moreover, I argue that this driver is further amplified when innovative production facilities are involved as their distinct features further signal independence from traditional production and may pose a threat to suppliers. However, also note that while Adidas succeeded in pressuring their suppliers (Interviewee A, personal communication, 10 Dec 2020), this might also evoke negative reactions by suppliers in other cases.

Proposition 3a: Firms can use reshoring to create leverage over existing offshore suppliers to lower their prices. The use of innovative production facilities supports this driver by further signaling independence from these suppliers and posing a distinct threat to them.

The second novel driver concerns the relation of reshoring and larger strategic plans. Adidas' vision to establish a distributed network of Speedfactories played a role in the reshoring decision as this was essentially the first step towards the envisioned transformation. Hence, reshoring can be part of a larger plan and serve as a harbinger of planned supply chain transformations. Specifically, firms with the vision of a distributed production network are likely to establish new local production hubs subsequently to limit risk exposure and financial commitment. When choosing the facility to be opened first, an onshore location emerges as a reasonable choice as the environment is known and further traditional reshoring motives might apply. This first facility can be equated with a partial reshoring of production, meaning that the vision of a distributed network can cause reshoring. This novel driver too is supported by innovative production facilities as these enable this vision by reducing labor costs and creating the flexibility to economically produce small volumes (Attaran, 2017; Laplume et al., 2016) as also seen in the case. While the specific vision may be unique to Adidas, this illustrates that reshoring in other cases may also only be part of a larger strategic plan.

Proposition 3b: Firms may reshore production as the first step to transform the supply chain from centralized production to a globally distributed production network with local hubs. In this process, innovative production facilities can serve as an enabler.

6.1.4 Implications of innovative production facilities on reshoring and offshoring

Having discussed all of the above effects on other drivers, I finally aim to derive implications of innovative production facilities on the result of the location decisions. The case illustrates that innovative production facilities can induce decisions for onshore and offshore locations alike. Initially, Adidas' strategic focus for the Speedfactory was on the further advancement of the innovative processes and demand

proximity to drastically increase speed, especially long-term via a distributed Speedfactory network. Consistently, I previously found that speed was Adidas' primary reason to reshore production. In contrast, Adidas later changed their strategy to focus on costs instead which resulted in the offshoring to reduce costs while Adidas simultaneously aimed to immediately scale the 4D production via offshoring. This comparison reveals that different priorities defined by firm strategy are the distinctive factor between both location decisions. Hence, innovative production facilities can imply different ideal locations depending on the strategy as well as short- and long-term goals.

Short-term, an offshore location as finally chosen by Adidas might boost profitability immediately. On the one hand, this is enabled by the reduction of production costs due to lower labor costs – despite lower relevance of labor costs as discussed, still some labor input is required – and, in Adidas' specific case, through joining the innovative 3D printing processes with the already for efficiency optimized traditional processes. On the other hand, the mass production capabilities of offshore suppliers can accelerate the scaling of production volumes to increase sales and yield economies of scale. Long-term, however, Adidas, at least initially, preferred the onshore location in line with their ultimate vision of a distributed production network to enable speed or else they would not have begun implementing this vision. This shows that the in the long-term hypothetically ideal location of production may differ from the location induced by short-term goals. However, choosing locations which might be optimal long-term but suboptimal short-term may require accepting lower profitability short-term and is risky as the potential benefits of the chosen location may erode over time.

Thus, a firm has to prioritize either the short-term or long-term evaluation of locations based on firm strategy. Different locations may be implicated for innovative production facilities depending on the firm's strategy. In line with this, Adidas shifted to a

cost focus and therefore abandoned their long-term vision to instead boost profitability short-term by offshoring the Speedfactory without major exogeneous changes.

Proposition 4: Depending on firm strategy, different locations can be implicated for innovative production facilities ceteris paribus.

6.2 Limitations

Several limitations may restrict the results. In the following, I will describe potential threats to the internal validity, referring to issues within data collection and case analysis, and to the external validity, i.e., the generalizability of results.

6.2.1 Internal validity

Multiple threats to the internal validity exist. Firstly, while I collected a high amount of information from various sources, not all developments are explicitly explained in detail but rather have to be inferred. Thus, the quality of the derived conclusions is dependent on my judgement and analytical abilities. Especially, for the offshoring of the Speedfactories, public communication by Adidas on the drivers of this decision is limited. Although I elaborately discussed these drivers in section 5.2 by providing supporting evidence, Adidas did not ultimately confirm the derived conclusions. Similarly, certain connections of drivers to the reshoring are only inferred from evidence. For instance, Adidas actively tried to profit from the made-in effect and used the Speedfactory as leverage against suppliers as discussed, however it remains unclear whether this was actually already considered when making the reshoring decision.

Additionally, the lack of internal views may limit the validity. The conducted interview illustrates that internal views can provide insights beyond public information. This might suggest that further interviews could provide additional, as of yet undiscovered findings, potentially inducing an omitted-variable bias here. Simultaneously,

the abundance of information contained in the conducted interview creates a high dependence on the interviewee. While the statements are partially corroborated by other sources and I judge the provided information to be reliable based on the explanatory power and the fit into the overall case narrative, the expressed views are likely to be subjective and thus may not be representative of Adidas. In addition, confidentiality concerns may also limit the quality of the interview as the interviewee was not allowed to disclose all details of the case.

Additional limitations result from the methodology. I acted as the single researcher for this case study and collected and analyzed all evidence myself. Hence, the results may be influenced by my subjective interpretations. For this reason, Merriam and Tisdell (2015) argue that trainings are required to prepare the researcher for the case study, which I did not receive. Moreover, the high exposure to Adidas throughout this study may have tainted my judgement by creating a positive bias towards the firm leading to the tendency to not view the case critically enough.

Further, the data collection occurred after the events of the case were concluded. Thus, direct field observations were not possible and instead I have to rely comparably more on secondary sources, i.e., reports of others that actually observed the events. These secondary sources may already represent the actual events inaccurately, albeit the convergence of information of multiple sources limits this issue. Finally, the procedure to find additional sources by following links in other sources may create biases. Statements corroborated by interrelated sources could falsely convey the precision of these statements.

Despite these potential limitations however, the convergence of evidence from various sources towards the depicted developments underpins the internal validity of this case

study. Additionally, I was able to answer and rule out potential rival explanations in chapter 5 while the derived conclusions sufficiently explain the collected data without leaving any loose ends. Thus, I believe that this study was able to overcome the majority of the outlined limitations.

6.2.2 External validity

Due to the single case study method, the results cannot simply be extrapolated. Hence, I do not claim that the same drivers necessarily apply to other location decisions with innovative production facilities. This case features a unique situation which may not be representative of other firms with innovative production facilities significantly different from the Speedfactory.

The specific modes of the decisions in the Speedfactory case potentially induce further limitations on the applicability of the derived propositions to other cases. The case only observed outsourced production. Hence, it might be possible that the results are not generalizable to location decisions in which different ownership modes are involved. Concurrently, Adidas was only relocating a small part of its production. For firms where location decisions affect more significant parts of production, different drivers may apply.

Lastly, the impact of this case study may be limited as innovative production facilities are rare compared to more traditional production facilities. However, the definition of innovative production facilities is broad and the detected concepts may also transpose to relatively less innovative facilities than the Speedfactory.

7 Conclusions

This paper provides insights into location decisions with innovative production facilities, a newly emerging subcategory of location decisions. Based on the case analysis,

I developed four sets of propositions regarding special characteristics of these decisions.

Key differences to standard production, i.e., distinct processes and I4.0 technologies, demand independently made location decisions for innovative production facilities. Nonetheless, the analyzed case shows that these decisions are driven by similar factors as other location decisions, albeit their importance may be weighed differently due to the moderating effect of innovative production facilities. Through increased automation, less manual labor is required in such factories making labor cost differentials less relevant for location. Moreover, the involvement of innovative and thus less mature processes, which may need further optimization, leads to a relative increase in importance of access to knowledge and capabilities to enable these enhancements. Hence, I conjecture that firms are more likely to co-locate innovative production facilities with R&D or key partners. Additionally, the made-in effect, which generally favors reshoring, may be more important in location decisions with innovative production facilities as the use of advanced manufacturing techniques essentially transforms the products into high-tech products leading to potential demand surges as in the Speedfactory case.

Furthermore, I observed, to my knowledge, novel reshoring drivers. First, firms can reshore with innovative production facilities to exercise pressure on offshore suppliers to lower their prices. Second, reshoring may be used as only the first step or test of a larger strategic plan such as transforming the supply chain from centralized production to globally distributed local hubs.

Lastly, the opposing outcomes of the two main location decisions in the case reveal corporate strategy and the relevant planning horizon as major determinants of how the location variables are evaluated. In the case, this is exhibited as a long-term focus led

to the reshoring of production with the Speedfactory whereas the shift to a short-term focus induced by a cost-strategy resulted in the later offshoring.

7.1 Managerial implications

These results have multiple implications on managerial practice. Clearly, the case underlines the complexity of location decisions with innovative production facilities. To make reasonable choices given this complexity, a high degree of involvement is required. Managers should not oversimplify the location decision by replicating the outcomes of previous location decisions, i.e., choosing the same location for new innovative production facilities, without further considerations.

Moreover, this paper also indicates several focal points to which practitioners should pay attention. To derive a competitive advantage from innovative facilities, firms need the right capabilities and knowledge. Hence, managers need to consider which location grants them access to such knowledge. The case also underlines that technologies gradually mitigate the relevance of labor costs. Although Adidas still offshored due to lower costs in Asia, managers should begin to prepare for a future disruption of cost benefits of offshore locations. Furthermore, firms may be able to use partial reshoring to create leverage over suppliers to drop prices. However, managers need to be aware that this is risky as suppliers may react negatively. Hence, the dependence of the suppliers on the firm and the firm's bargaining power should be determined beforehand.

In addition, long-term planning is needed. The Speedfactory case illustrates that shifts in strategy can cause costly relocations. Therefore, firms need to carefully analyze which locations are in line with and advance firm strategy. Concurrently, firms should try to anticipate whether future strategy adjustments are imminent and how these could affect the location of innovative production facilities to avoid making decisions that

need to be revoked again soon after as exhibited by the offshoring of the Speedfactories. Here, managers need to weigh the short- and long-term implications of the location decision. A firm that is doing well may accept short-term losses to create larger future potential by further exploring the innovative processes whereas a firm making losses could be forced to choose a location to best exploit the current processes.

7.2 Research directions

Finally, I suggest several directions for future research. To understand location decisions with innovative production facilities better, these facilities need to be investigated further. Studies on their occurrence and classifications according to their degree of innovativeness will help clarify the still fuzzy definition.

In a next step, future research can further explore my propositions. Especially sets two and three require additional studies to identify in which other cases the detected effects apply. Moreover, further case studies of comparable state-of-the-art projects such as Tesla's Gigafactory might reveal additional insights to complement my findings. Simultaneously, a broader investigation of this research field is needed by studying multiple firms to identify how location decisions with innovative production facilities change across industries, firm sizes and other firm-specific factors. Further, comparative case studies on the effect of different relocation modes could enhance the understanding of the decisions. In Adidas' case, on- and offshore production was outsourced. For firms producing in-source or for which the relocation comes with a change of ownership, systematically different location drivers may apply. Similarly, the scale of the reshoring is of interest for future research. Adidas reshored only a small part of their total production. Here, researchers can analyze whether relocations with innovative production facilities involving a higher fraction of production yield systematically different results.

Lastly, quantitative studies on the ramifications of location decisions with innovative production facilities are needed to explore the effect of the chosen location and the underlying drivers on factory and firm performance afterwards.

Appendix

A Figures

Figure 7 – Futurecraft M.F.G. and AM4TKY

The image comparison of the Futurecraft M.F.G. (top) and the AM4 series, here the AM4TKY (bottom) is depicted, shows the similarities throughout the Speedfactory models. All models have the same basic outline by featuring a Boost midsole and an upper made out of one piece of Primeknit. Only the colors and minor design features such as laces and strips stuck on the upper differ across models.

Sources: Adidas (2016e, 2018e).

Figure 8 – Futurecraft 4D and ZX 4000 4D

The figure shows images of the first 4D model Futurecraft 4D (top) and a 4D model from 2019, the ZX 4000 4D (bottom). Both models exhibit the characteristic 3D printed midsole with its lattice structure, which all 4D models feature. Both midsoles are in the 4D-signature color "aero green". Further, the figure shows the differences across 4D models as the ZX 4000 4D features a completely different upper, which consists of patches of multiple different materials and is identical to the upper of classical ZX 4000 models.

Sources: Cheng (2018), Adidas (2019g).

B Lists

List 1 – Questions guiding the data collection procedure

A. General questions:
    1. When was the Speedfactory planned?
    2. Why was it created?
    3. What was the specific aim of introducing the Speedfactory?
    4. When and how was it built?
    5. How does the Speedfactory differ from other factories?
    6. How do the processes within the Speedfactory look like?

B. Technology:
    1. Which technologies are used within the Speedfactory?
    2. Have the technologies been specifically designed for the Speedfactory?
    3. Were the technologies developed internally?
    4. Which roles did the partnerships have in the development?
    5. Why were processes automated?
    6. How were processes automated?
    7. Was full automation the goal and was it achieved?

8. Why were 3D printers employed?
9. Since when were 3D printers used?
10. Were 3D printers initially used for rapid prototyping?
11. In how far was “rapid prototyping” involved in the Speedfactory?
12. Which material is the Futurecraft 4D sole made of? TPU?

C. Organization:

1. How was the Speedfactory implemented in and incorporated into the existing organization and supply chain?
2. Who operated the Speedfactory?
3. What is the difference in supplier networks to the standard business?
4. Which changes in the supply chain were necessary to implement the Speedfactory?
5. When is ownership of goods traditionally transferred and what about with the Speedfactory?
6. Was the Speedfactory part of another business unit?
7. Were there interactions between the Speedfactory and other parts of the organization?
8. What partnerships exist in relation to the project?
9. Why was it set up in Germany and US?
10. Why was the Speedfactory opened in Ansbach?
11. Why was Atlanta chosen for the second Speedfactory?
12. Were there differences between the two Speedfactories?
13. Did environmental impact influence the decision to reshore production?

D. Business model:

1. How was the business model parameterized, how did it evolve?
2. What was the business model behind the Speedfactory?
3. Why did the business model evolve over time?
4. What were the main KPIs of the Speedfactory?
5. What was the purpose of the Speedfactory?
6. What were the future plans for Speedfactories (expansion, synthesis etc.)?
7. How can Speedfactories contribute to a competitive advantage?
8. How is the Speedfactory related to the importance of short lead times?
9. How did the lead time compare to normal shoes?
10. What was the effect of the closeness of the Speedfactory of the market?
11. What role did customization play?
12. Were prestige and media attention relevant KPIs?
13. What products were produced at the Speedfactory?
14. Were shoes with Boost soles and 4D shoes produced in the Speedfactory?
15. Did AM4 models involve 3D printing?
16. Were 4D shoes produced in the Speedfactory and if yes all?

17. How do the products relate to other products (target group, design, performance etc.)?
18. How big was the hype around the products?
19. How big was the demand for the products?

E. Termination:
    1. What led to its stopping in Germany and the US?
    2. Why were the Speedfactories closed?
    3. Why at this specific point in time?
    4. Were the products responsible for the termination?
    5. Which external factors (environment, macro, competition) contributed?
    6. Was the decision made independently for both Speedfactories?
    7. Was the decision planned ahead or made during the process?
    8. Are there plans for reshoring production again in the future?
    9. How did the distance to the suppliers effect the project?
    10. How did Adidas cope with the sunk costs?
    11. What ramifications did the closing of the Speedfactories have?
    12. What was the projected reaction of the public?
    13. What were the goals in communicating the termination both internally and externally?
    14. Do the involved partnerships still continue?
    15. Were the two Speedfactories test beds or were they more than that?
    16. What are the findings from the operation of the Speedfactories and technologies?

F. Transfer to Asia:
    1. Why was it transferred? What is happening now? How successful is the Speedfactory in Asia?
    2. Why was the Speedfactory technology transferred to Asia?
    3. Was the technology integrated into existing processes, were the Speedfactory processes copied or were new processes created?
    4. Speedfactories have been associated with short lead times, how relevant is the importance of lead times after the transfer to Asia and why?
    5. What modifications to the organization were necessary for the implementation in Asia?
    6. Why is the technology more useful in Asia than onshore?
    7. Do existing structures limit the potential of the technology (compared specifically for them designed structures)?
    8. How difficult is the transfer and integration of such innovative processes?
    9. Do synergies to existing structures within Asia exist?
    10. What benefits are expected from the transfer?
    11. What changes to the supplier network were required?
    12. Were the same partners involved?
    13. What exactly is transferred to Asia?

14. What effect did the transfer have on the overall costs?
15. Is the transfer already happening?
16. What are the first results of the transfer?
17. What are the future plans for the Speedfactories?
18. How to deal with rising costs (labor, leasing, shipping costs) in Asia?
19. Was the possibility of integrating the technology in existing factories considered or planned from the beginning?
20. Why was it not integrated until recently?
21. Are fully automated Speedfactories still envisioned?
22. Are Speedfactories outside of Asia planned in the future?
23. Why are traditional issues of offshoring that favor reshoring not relevant here?
24. Does the Speedfactory technology in Asia overcome the issues of offshoring?
25. How does the new technology affect lead times from Asia?
26. Is there a risk of IP loss in Asia?
27. In how far is proximity to R&D important?
28. Who are the local partners in Asia?
29. What specific knowledge to suppliers possess?
30. How do new 4D products relate to Asian operations, are they produced there?
31. Where are 4D shoes produced now?

List 2 – Prepared interview questions for Interviewee A

1. Describe your position at Adidas and how it is connected to the Speedfactory.
2. In your words, can you describe the concept of the Speedfactories and the goals and vision of the project?
3. What was the main innovation of the Speedfactory and how did technologies enable the concept?
4. What was the role of 3D printing in the Speedfactories? Were the Adidas 4D products also produced in the Speedfactories?
5. Can you elaborate on the importance of collaboration and why Adidas chose to work with external partners for the Speedfactory?
6. How was the Speedfactory implemented in and incorporated into the existing organization and supply chain?
7. Did the Speedfactory have its own supplier network?
8. How was the Speedfactory business model parameterized? How did it evolve over time? What were main KPIs?
9. What led to the stop of the project in Germany and the US?
10. Why was the concept transferred to Asia?
11. Which technologies were transferred?
12. What is happening now? Was the transfer successful?
13. Are the partners of the Speedfactory project still involved after the transfer?

14. How do the shoes from the Speedfactory compare to other Adidas products? How do the technologies impact the products?
15. Does the original vision of a distributed Speedfactory network to serve local markets still exist?

C Tables

Table 1 – Adidas' AM4 series from the Speedfactory

The table depicts all detected models of the AM4 series sorted by release date. The *Release Date* is in the format DD.MM.YY.. *Name* refers to the official product name by Adidas. *Release Type* differentiates between pilots for testing, limited editions, i.e. releases in fixed and small quantities, and internal releases to associates of Adidas. *Prices* are in Dollars as given by the sources, '?' indicates that no retail prices were found, prices marked with '*' were not indicated in the source but obtained from StockX.com. *City/Event/Collaborator* refers to either the city (city series) or the event for which the product was released or the partners for the product in case of special collaborations.

Release Date	Name	Release Type	Price	City / Event / Collaborator	Source
21.09.16	Futurecraft MFG	Pilot	$250*	Berlin, Berlin Marathon	Adidas (2016e)
19.10.17	AM4LDN	Limited Edition	$220*	London	Adidas (2017d)
26.10.17	AM4PAR	Limited Edition	$220*	Paris	Adidas (2017d)
05.02.18	AM4MN	Limited Edition	?	Minnesota, Super Bowl	Adidas (2018f)
17.02.18	AM4LA 747 Warehouse	Limited Edition	$220*	Los Angeles	Goat (n.d. a)
26.04.18	AM4NYC	Limited Edition	$200	New York City	StockX (2021h)
08.06.18	AM4LA	Limited Edition	$200	Los Angeles, Parley for the Oceans	Grailify (n.d. b)
22.06.18	AM4NHL Washington Capitals	Limited Edition	$200	NHL title of the Washington Capitals	Goat (n.d. b)
27.07.18	AM4SH	Limited Edition	$200	Shanghai	StockX (2021q)
28.07.18	AM4MLS	Limited Edition	?	MLS Allstar Game	Adidas (2018c)
27.08.18	AM4BJK	Limited Edition	$200	US Open, Billie Jean King	Adidas (2018g)
18.09.18	AM4COBE	Internal Release	–	COBE Architects	Benson (2018)
20.09.18	AM4TKY	Limited Edition	$200	Tokyo	Adidas (2018e)

06.10.18	AM4 Overkill	Limited Edition	$220*	Overkill	Sawyer (2018)
08.10.18	AM4 Atmos	Limited Edition	$200	Atmoscon	Destefano (2018)
29.10.18	AM4BSBL	Limited Edition	$200	Major League Baseball	Adidas (2018d)
06.12.18	AM4 Aaron Kai	Limited Edition	$200	Aaron Kai	Jones (2018)
08.12.18	AM4 Kwasi	Limited Edition	$200	Kwasi	Jones (2018)
13.12.18	AM4 Brooklyn Ballet	Limited Edition	$200	Brooklyn Ballet	Jones (2018)
20.12.18	AM4 Sadelle's	Limited Edition	$200	Sadelle's	Briguglio (2018)
01.01.19	AM4 CNY	Limited Edition	?	Chinese New Year	StockX (2021o)
28.01.19	AM4ATL	Limited Edition	$200	Atlanta, Pro Bowl	JustFreshKicks (2019g)
31.01.19	AM4DET	Limited Edition	$200	Detroit	StockX (2021p)
17.02.19	AM4TB	Limited Edition	$200	NHL title of the Tampa Bay Lightnings	JustFreshKicks (2019b)
26.04.19	AM4 "Thanos"	Limited Edition	$150	Marvel's Avengers: Endgame	JustFreshKicks (2019a)
26.04.19	AM4 "Captain Marvel"	Limited Edition	$150	Marvel's Avengers: Endgame	JustFreshKicks (2019a)
April 19	Futurecraft Loop	Pilot	–	–	Adidas (2019h)
11.05.19	AM4 Creators Club	Limited Edition	$150	Adidas Creators Club	StockX (2021r)
25.05.19	AM4GOT	Limited Edition	$150	Game of Thrones series final	JustFreshKicks (2019f)
01.06.19	AM4 "Berlin"	Limited Edition	$150	Berlin	JustFreshKicks (2019h)
28.06.19	AM4 KTN	Limited Edition	?	DJ Kittens	Smalls (2019)
13.07.19	AM4 Knight	Limited Edition	$150	JaQuel Knight	StockX (2021t)
26.07.19	AM4 Milan	Limited Edition	$150	Milan	JustFreshKicks (2019d)
Before 21.08.19	AM4 Parley RFTO	Limited Edition	$150	Parley for the Oceans	Golem (n.d.)
24.09.19	AM4 Pat Mahomes Showtime	Limited Edition	$150	NFL MVP Patrick Mahomes	StockX (2021u)
10.10.19	AM4 Alsacia	Limited Edition	?	Greenhouse, Tony Peralta, Hispanic Heritage	Jones (2019)
10.10.19	AM4 Platanos	Limited Edition	?	Greenhouse, Lucia Hierro, Hispanic Heritage	Jones (2019)

10.10.19	AM4 Mexico	Limited Edition	?	Greenhouse, Bryan Avila, Hispanic Heritage	Jones (2019)
16.10.19	AM4UW "Huskies"	Limited Edition	$150	University of Washington, College Football	StockX (2021w)
18.10.19	AM4 Marvel 80 Vol. 1	Limited Edition	$150	Marvel Anniversary	Santiago (2019)
18.10.19	AM4 Marvel 80 Vol. 2	Limited Edition	$150	Marvel Anniversary	Santiago (2019)
22.10.19	AM4 FC Bayern Team Alaba	Limited Edition	$200	FC Bayern München	Nur Fussball (2019)
31.10.19	AM4 "Cryptic Waves"	Limited Edition	$150	*unknown*	StockX (2021s)
10.11.19	AM4 VIT.01	Limited Edition	$175	Team Vitality	StockX (2021v)
17.11.19	AM4 World Champions	Limited Edition	?	NBA title of the Toronto Raptors	Chin (2019)
Nov 19	Futurecraft Loop Gen 2	Pilot	–	–	Adidas (2019h)
20.12.19	AM4 "The Force"	Limited Edition	?	Star Wars	JustFreshKicks (2019i)

Table 2 – Adidas' 4D-series

The table depicts all detected models of the 4D series sorted by release date. Only releases of new models or updates of previous models, i.e., next generations, are included, but not releases of additional colors of previous models. The *Release Date* is in the format DD.MM.YY.. *Name* refers to the official product name by Adidas. *Release Type* differentiates between pilots for testing, limited editions, i.e. releases in fixed and small quantities, internal releases to associates of Adidas, reveals (meaning that the later launch date was not yet available) and normal full releases indicated by '–'. *Prices* are in Dollars as given by the sources, '?' indicates that no retail prices were found, prices marked with '*' were not indicated in the source but obtained from StockX.com. *Collaborator / Notes* refers to names of partners in case of special collaborations and may also contain additional notes.

Release Date	Name	Release Type	Price	Collaborator / Notes	Source
15.12.16	3D Runner	Pilot	$333	–	Saunders (2016)
01.01.18	Futurecraft 4D "Friends & Family"	Internal Release	–	–	StockX (2021j)
18.01.18	Futurecraft 4D	Limited Edition	$300	–	Chang (2018)
10.02.18	Futurecraft 4D	Limited Edition	$300	–	Montes (2018)
17.02.18	Alphaedge 4D LTD	Limited Edition	$300	–	Rouse (2018)

23.02.18	Y-3 Runner 4D	Limited Edition	$535	–	JustFresh-Kicks (2018a)
20.06.18	4D Sneakersnstuff	Limited Edition	$450	Sneakersnstuff	Boykins (2018)
04.08.18	Futurecraft 4D Invincible Prism	Limited Edition	$400	Invincible	StockX (2021l)
07.09.18	Y-3 Runner 4D II	–	$600	–	StockX (2021z)
22.09.18	Futurecraft 4D Footpatrol	Limited Edition	$525	Footpatrol	StockX (2021k)
06.10.18	Futurecraft 4D-5923	–	$350	–	StockX (2021a)
12.10.18	Futurecraft 4D Arsham Future	Limited Edition	$450	Daniel Arsham	JustFresh-Kicks (2018b)
02.11.18	Consortium 4D Kith Aspen	Limited Edition	$500	Kith Aspen	Ofiaza (2018)
17.11.18	Alphaedge 4D	–	$300	–	Adidas (2018b)
21.11.18	Futurecraft 4D “Onix Aero Green”	–	$450	–	StockX (2021m)
09.02.19	ZX4000 4D	–	$350	–	Adidas (2019g)
16.04.19	Alphaedge 4D McCartney	Limited Edition	$400	–	Stella McCartney (2019
08.06.19	Alphaedge 4D Parley	–	$300	Parley for the Oceans	StockX (2021e)
22.06.19	ZX4000 4D Hender Scheme	–	$350	Hender Scheme	Adidas (2019f)
29.06.19	Consortium Runner Mid 4D	–	$400	–	Adidas (2019c)
01.07.19	Alphaedge 4D Stella McCartney	–	$450	–	StockX (2021g)
22.07.19	Alphaedge 2 4D	–	$300	–	StockX (2021d)
14.09.19	ZX 4000 4D “I Want I Can”	–	$300	–	Gorsler (2019)
09.11.19	ZX 4000 4D “Sunrise“	Limited Edition	$300	Sneakersnstuff	StockX (2021ab)
09.11.19	ZX 4000 4D “Sunset“	Limited Edition	$300	Sneakersnstuff	StockX (2021ac)
09.11.19	I-4D	–	$300	–	Grailify (n.d. a)
11.11.19	Alphaedge 4D “Reflective”	–	$300	–	Adidas (2019a)
21.11.19	Alphaedge 4D “Death Star”	–	$300	Star Wars	StockX (2021f)
10.12.19	Y-3 Runner 4D	–	$600	–	StockX (2021y)

20.12.19	Pharrell Williams 4D Runner	–	$400	–	Adidas (2019e)
21.12.19	Consortium Runner 4D V2	–	$350	–	Sawyer (2019)
18.01.20	Alphaedge 4D Stella McCartney	–	$300*	–	Vuong (2020)
30.01.20	Parley 4D Run 1.0 LTD	Limited Edition	$220	Parley for the Oceans	StockX (2021b)
25.02.20	4D Run 1.0	–	$220	–	StockX (2021c)
03.03.20	Consortium Evo 4D F&F Paris Fashion Week	Internal Release	–	–	Brain (2020a)
19.03.20	Y-3 Runner 4D	–	$500	–	StockX (2021x)
11.04.20	ZX 2K 4D	–	$200	–	StockX (2021aa)
09.05.20	ZX 4D Morphe	Reveal	?	–	JustFresh-Kicks (2020a)
14.07.20	X9000 4D	Reveal	?	–	JustFresh-Kicks (2020d)
06.08.20	I-4D	Reveal	$350	–	JustFresh-Kicks (2020b)
07.08.20	Parley x adidas Ultra Boost 4D Uncaged	–	$200	Parley for the Oceans	JustFresh-Kicks (2020f)
13.08.20	Ultra 4D	–	$220	–	JustFresh-Kicks (2020e)
08.10.20	Futurecraft Strung 4D (Concept)	Reveal	?	Release in 2021/2020	Adidas (2020d)
08.10.20	Glide 4D	Reveal	?	–	JustFresh-Kicks (2020c)
16.10.20	ZX Runner 4D	–	$200	–	StockX (2021ad)
23.10.20	Evo 4D End “Dune”	–	$275	End clothing	Briguglio (2020)
01.11.20	Y-3 Runner 4D IO	–	$450	–	Brain (2020b)
06.11.20	IIM 4D	Reveal	?	–	Sneaker Freaker (2020)
20.11.20	Ultra 4D Packer	Limited Edition	$250	Packer	Sawyer (2020)
26.11.20	EVO 4D End “Dark Matter”	Limited Edition	$275	End clothing	End Clothing (2020)
27.11.20	4D Runner AEC	–	$200	–	Gorsler (2020)
03.12.20	Nasa Ultra 4D 5.0	–	$220	Nasa	Le (2020)
04.12.20	Ultra 4D Social Status	Limited Edition	?	Social Status	Hernandez (2020)

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